ARCO METALS COMPANY

COLUMBIA FALLS REDUCTION PLANT

INFORMATION MANUAL

This information manual on the Columbia Falls, Montana, Reduction Plant is supplied to

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for review in accordance with the Confidentiality Agreement between ARCO Metals and the subject Company which was signed on

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The book is to be returned in its entirety to:

ARCO Metals Company
Two Continental Towers
1701 Golf Road
Rolling Meadows, IL 60008
c/o Vice President - Business Development

Manual #7
J.E.G. Bischof

COLUMBIA FALLS INFORMATION MANUAL

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FACILITY OVERVIEW

INTRODUCTION

Columbia Falls Aluminum Reduction Plant is a vertical stud Soderberg smelter that has been modified with Sumitomo process technology. The plant has a rated production capacity of 180,000 tons of primary aluminum per year.

Three thousand feet above sea level and sixty miles south of the Canadian border, the plant site consists of 3,932 acres of land and two million square feet of covered floor space. Six hundred aluminum reduction cells in five pot lines provide metal to a cast house with nine furnaces, five casting pits, and one pig casting machine. A rod mill complex is also located at the site.

The total workforce, when the plant operated near full capacity during 1981, averaged 1230 employees; the population of the surrounding county is forty-five thousand. Hourly workers are represented by the Aluminum Workers Trades Council AFL-CIO.

FACILITY HISTORY

In 1948 construction began on the Hungry Horse Dam in the Flathead Valley of Montana. The dam was the first major hydroelectric dam to be built after World War II. As construction neared completion local efforts were mounted to attract an aluminum producer to the area. An aluminum plant would utilize electricity produced at the dam and would reduce the migration of workers from the region after the dam was finished. Encouragement came in 1950 when Harvey Machine Company of Torrence, California acquired options for an aluminum plant in the Flathead Valley and purchased a thousand acres of land six miles north of Kalispell.

Unfortunately, Harvey was unable to obtain financing to build the plant. But on November 6, 1951, the Anaconda Copper Mining Company announced that it had acquired 95 percent of Harvey's interests. The Federal Trade Commission expressed concern over Anaconda Copper Mining Company, one of the three biggest copper producers, becoming the fourth producer of aluminum. However, President Truman intervened to direct that development of the plant continue.

On August 30, 1952, C.F. Kelly, Chairman of the Board, Anaconda Copper Mining Company announced that Anaconda would build an aluminum reduction plant two miles northeast of Columbia Falls near Teakettle Mountain. Site clearing started on September 16, 1952 and the first aluminum was produced on August 12, 1955. This initial construction consisted of two pot lines with an annual production capacity of 67,500 tons.

Ten years later, in 1965, a third pot line was added, increasing production capacity to 100,000 tons. Fourth and fifth pot lines were added in 1968, bringing production capacity up to its current level of 180,000 tons per year.

In 1977 construction began on a $42 million project to modernize Columbia Falls with technology licensed from Sumitomo Aluminium. By 1981 conversion was completed on all 600 cells at Columbia Falls. Through the use of hooded reduction cells and other equipment to provide tighter control of the reduction process, the Sumitomo process has substantially reduced emissions and power consumption while improving materials handling and working conditions. Today, Columbia Falls is the only Sumitomo licensee in the world that has successfully converted an entire plant to Sumitomo technology.

PRODUCTION PROCESS AND PHYSICAL ASSETS

Columbia Falls is a virtually self-sufficient primary aluminum smelter. Facilities exist to unload and store raw materials, process and fabricate anode assemblies, disassemble and rebuild spent reduction cells, smelt and cast molten aluminum, and load and ship resultant aluminum products.

Alumina, the basic raw material from which aluminum is produced, is refined from bauxite clay. Columbia Falls' alumina, supplied through long term contracts with Alumax, originates in Australia. There bauxite is taken from the earth's crust by open-pit mining, refined into sandy alumina by the Bayer process, and loaded onto ships at ports in the Kwinana/Bunbury Western Australia range.

Ownership is transferred from Alumax to ARCO upon delivery, F.O.B. vessel. ARCO transports the alumina by ocean freight to Everett, Washington where it is unloaded by clam shell bucket. Port of Everett storage capacity is 55,000 short tons. Alumina is transported from Everett, Washington to the Columbia Falls plant by bottom-dump gondola railroad cars where it is unloaded into bucket elevators and transferred to storage silos. These silos have a storage capacity of 59,000 short tons with auxiliary facilities providing an additional 36,000 short tons of storage.

Petroleum coke and coal tar pitch are the primary raw materials used in the in-house manufacture of carbon paste briquettes. These briquettes are used to replenish the sacrificial anode consumed during the electrolitic reduction process. Columbia Falls has facilities to: unload and store anode-related raw materials; crush, separate and classify petroleum coke; weigh and mix anode paste; and extrude and store anode briquettes.

Anthracite coal and soft pitch are the principal raw materials used in the internal manufacture of cathode carbon paste. The cathode shell of a reduction cell is constructed of sturdy steel and is lined by insulation materials and carbon block assemblies. During the rebuilding process the insulation material and carbon block assemblies, supplied by outside vendors, are replaced and the cathode interior lined and sealed with cathode carbon paste. Columbia Falls has facilities to unload and store cathode-related raw materials, crush and separate anthracite coals, and weigh and mix cathode carbon paste. Columbia Falls also has a complete group of ancillary facilities associated with the pot rebuild process.

Aluminum fluoride and cryolite are the principal chemicals composing the bath solution which floats on the molten aluminum metal pad in the reduction cell. This bath is in contact with the operational face of the anode and, as a liquid, serves to separate the alumina into its respective elements, aluminum and oxygen. As a solid near the surface, the bath serves to preheat the alumina, chemical and alloying materials as they are introduced to the cell and to form a positive seal for efficient collection of reduction gases.

The reduction cells (pots) are the focal point in the primary production process. At Columbia Falls there are 600 Vertical Stud Soderberg cells equally distributed among 10 potrooms; two potrooms equal one potline. All bulk storage raw materials are transferred to the cells by specially designed vehicles. Dispensing these material is done by operator control as the vehicles travel parallel to the pot on either the front or back side. Cell operations are normally controlled by a process computer but may be individually placed on manual control when necessary.

Electricity is the final raw material used in the reduction process. Columbia Falls electricity is supplied principally from hydro-electric power generated from the many dams on the Columbia River and its tributaries. Alternating current supplied by the Bonneville Power Administration is converted to direct current by water-cooled or air-cooled rectifiers. The direct current flows from the anode to the cathode and serves to provide a source of heat to the reduction cell and serves as the direct stimulus to the electrolytic process.

Each reduction cell produces approximately 1,600 pounds of aluminum per day; pots are tapped every other day by the siphon principle and molten metal is transferred by crucible and fork truck to a centrally located casting department. Most alloying is done in the holding and casting furnaces based on feedback from the quantometer in an in-house chemical laboratory. Casting the various sized and shaped ingots is based on the direct chill principle. Columbia Falls casting facilities include nine furnaces, five casting pits and one pig casting machine.

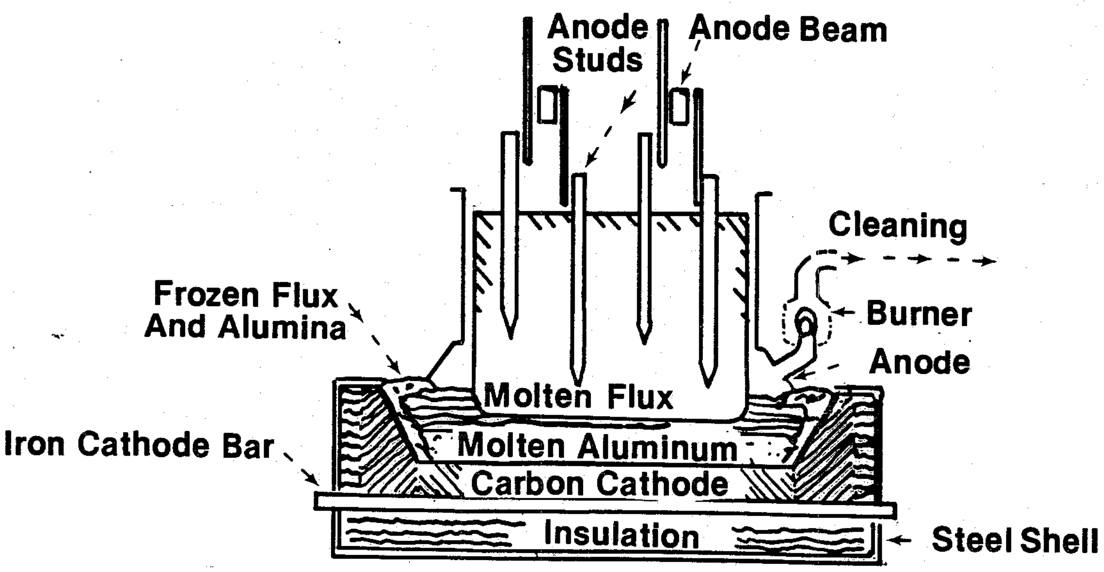
Shipments of primary products are made principally on the Burlington Northern Railroad. Columbia Falls operates and maintains its own switch engine and railcars are weighed both in and out.

The operating, maintenance and service departments include a variety of ancillary vehicular and power-driven equipment necessary for an aluminum plant of Columbia Falls design and location.

Vertical Stud Soderberg Cell

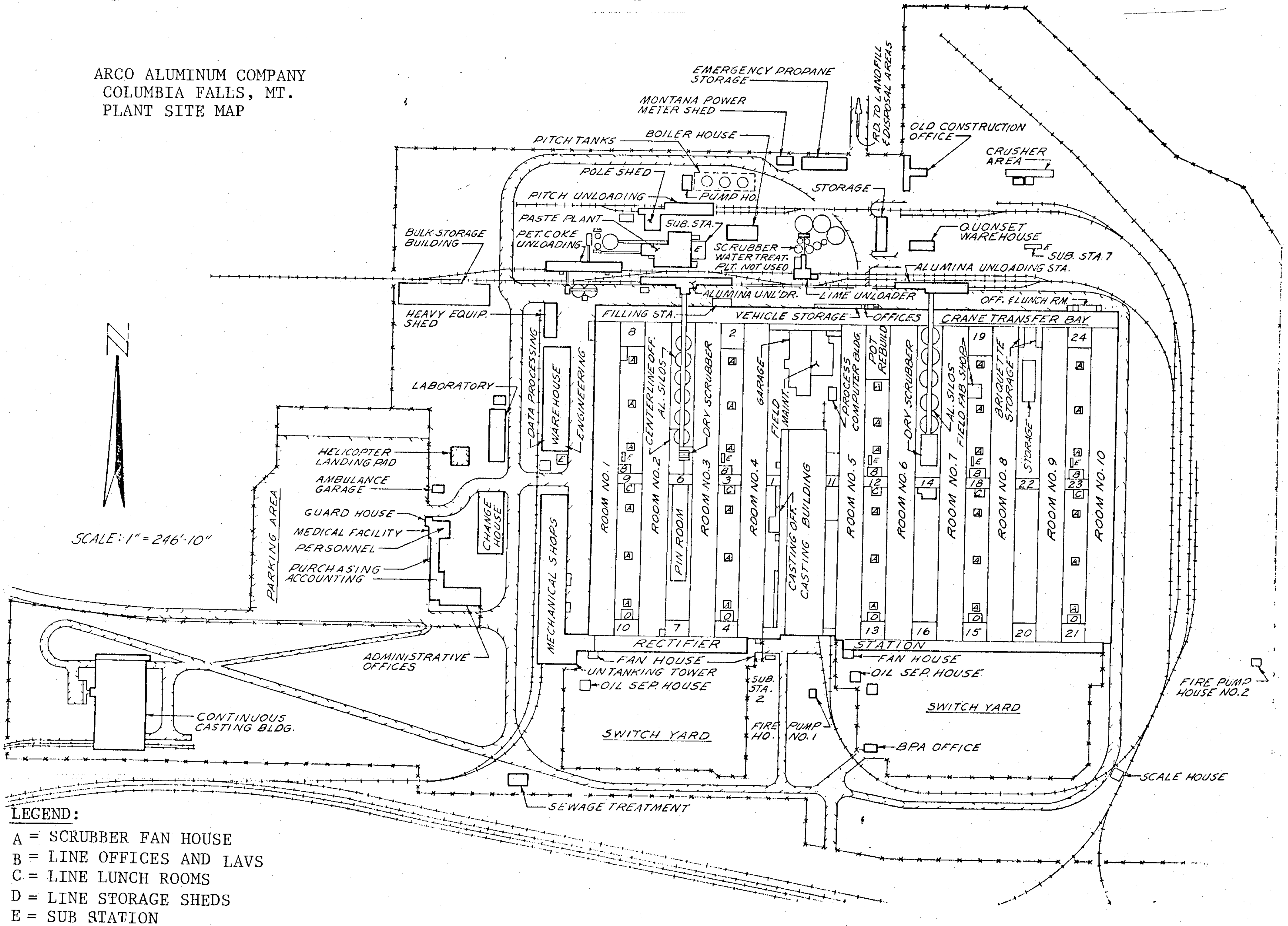
Alumina (Al_2O_3) is dissolved in molten cryolite (Na_3AlF_6) and is reduced to aluminum metal by direct current electrolysis. The released oxygen rises through the electrolyte and reacts with the sacrificial carbon of the anode, while the molten aluminum settles to the bottom of the reduction cell.

Vertical Stud Soderberg Cell



Rev 3/15/83

ARCO ALUMINUM COMPANY
COLUMBIA FALLS, MT.
PLANT SITE MAP



LEGEND:

A = SCRUBBER FAN HOUSE
B = LINE OFFICES AND LAVS
C = LINE LUNCH ROOMS
D = LINE STORAGE SHEDS
E = SUB STATION

PHYSICAL ASSETS

ANODE DRY RAW MATERIALS EQUIPMENT

&

ANODE PASTE SYSTEM

ANODE DRY RAW MATERIALS

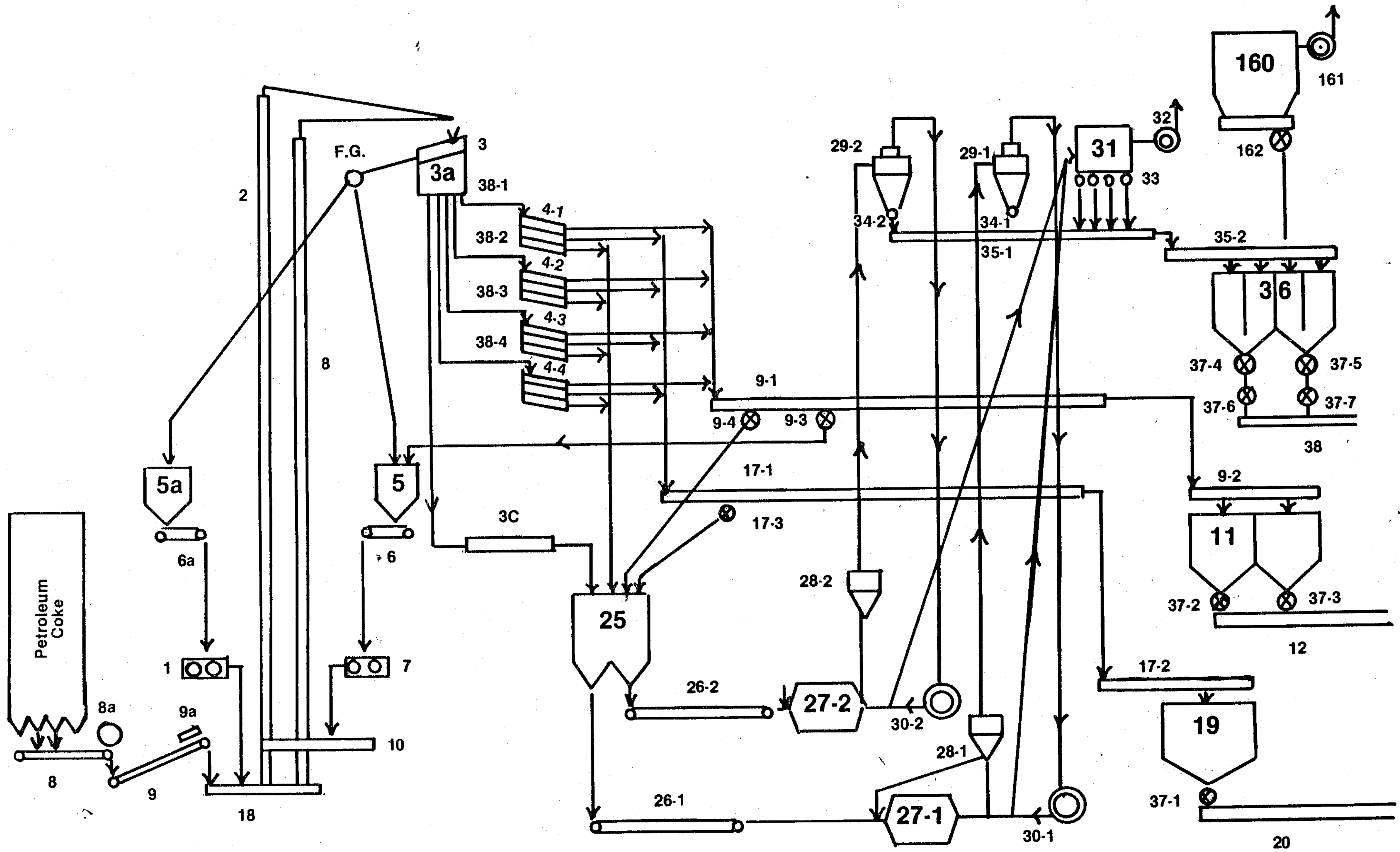
Petroleum Coke Silo 3,092 Ton Capacity

#1	Crusher, doubleroll, 12 1/2 ton/hour
#2	Elevator, spaced bucket, 30 ton/hour capacity
#3	Vibrating Screen, single surface, 1/2" mesh, 25 ton/hour
#3A	Surge Hopper
#3B-1 thru 3B-4	Screw Conveyors, 4 each, 5 ton/hour capacity
#3C	Screw Conveyor, 18 ton/hour capacity
#4-1 thru 4-4	Vibrating Screen, 4 each, two surface 14/65 mesh, 6 1/4 ton/hour capacity
#5 & 5A	Bin, crusher feed, 2 each, 13-20 ton capacity
#6 & 6A	Volumetric Belt Feeder, 2 each, 4-12 ton/hour
#7	Crusher, doubleroll, 10 ton/hour capacity
#8	Belt Conveyor, variable speed
#8	Elevator, spaced bucket, 30 ton/hour capacity
#8A	Weightometer speed control
#9	Belt Conveyor, 10-20 ton/hour capacity
#9A	Electro-magnet
#9-1 & 9-2	Screw Conveyor, 2 each, 15 ton/hour capacity
#9-3 & 9-4	Rotary Vane Feeder, 2 each, 16 ton/hour capacity
#10	Screw Conveyor, 10 ton/hour capacity
#11	Storage Bin, 2 compartments, 73.6 ton capacity
#12	Screw Conveyor, 6 ton/hour capacity
#13	Magnetic Separator, 6 ton/hour capacity
#14	Elevator, spaced bucket, 6 ton/hour capacity
#15	Bin, scale feed, 19.7 ton capacity
#16	Scale, belt feed
#17-1 & 17-2	Screw Conveyor, 2 each, 8 ton/hour capacity
#17-3	Rotary Vane Feeder, 8 ton/hour capacity
#18	Screw Conveyor, 25 ton/hour capacity
#19	Storage Bin, 40 ton capacity
#20	Screw Conveyor, 5 ton/hour capacity
#21	Magnetic Separator, 4 ton/hour capacity
#22	Elevator, spaced bucket, 4 ton/hour
#23	Bin, scale feed, 20.7 ton capacity
#24	Scale, duo-screw feed
#25	Storage Bin, ball mill feed, 38 ton capacity
#26-1 & 26-2	Volumetric Belt Feeder, 2 each, variable speed, 2-6 ton/hour capacity

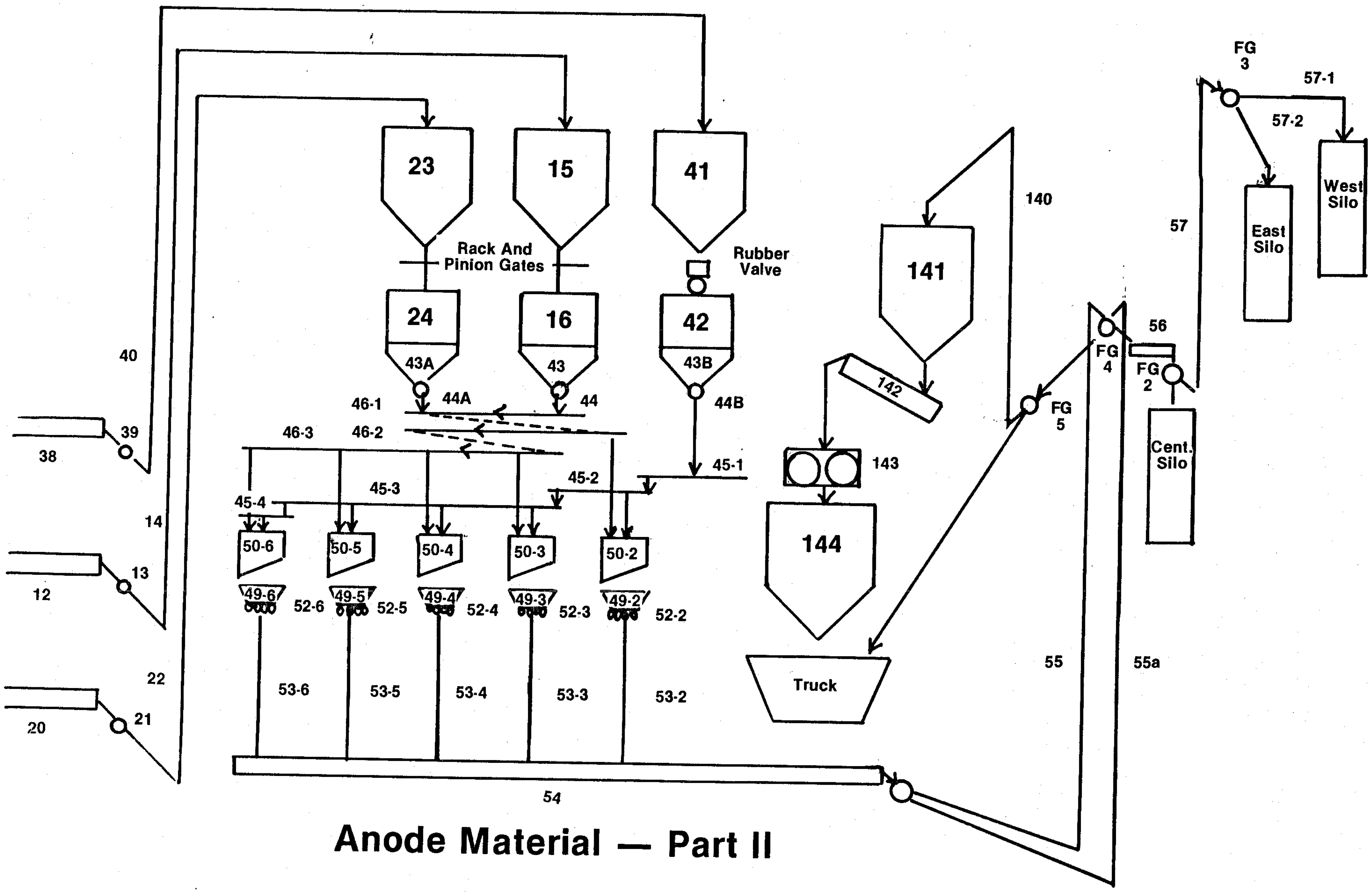
#27-1 & 27-2	Wind Swept Ball Mill, 2 each RPM, 5 ton/hour capacity
#28-1 & 28-2	Classifier, 2 each, gravity discharge
#29-1 & 29-2	Cyclone, 2 each
#30-1 & 30-2	Exhauster Fan, 2 each
#31	Dracco Dust Collector, 4 compartments
#32	Dracco Fan
#33-1 thru 33-4	Air Lock, 4 each, one from each Dracco unit
#34-1 & 34-2	Air Lock, 2 each, one from each cyclone
#35-1 & 35-2	Screw Conveyor, 2 each, 12 ton/hour capacity
#36	Storage Bin, 4 compartments, 150 ton capacity
#37-1 thru 37-5	Rotary Vane Feeder, 5 each, from intermediate storage bins
#37-6 & 37-7	Ramsey Gate Valves
#38	Screw Conveyor, 10 ton/hour capacity
#39	Magnetic Separator, 10 ton/hour capacity
#40	Elevator, spaced bucket, 10 ton/hour capacity
#41	Bin, scale feed, 32 ton capacity
#42	Scale, duo-screw feed
#43, 43A, & 43B	Scale Discharge Hopper, 3 each
#44, 44A, & 44B	Rotary Vane Feeder, 3 each, one from each scale hopper
#45-1 thru 45-4	Screw Conveyor, 4 each, 15 ton/hour capacity
#46-1 thru 46-3	Screw Conveyor, 3 each, 15 ton/hour capacity
#160	Anode Dust Control
#161	Fan, dust control
#162	Screw Conveyor

ANODE PASTE SYSTEM

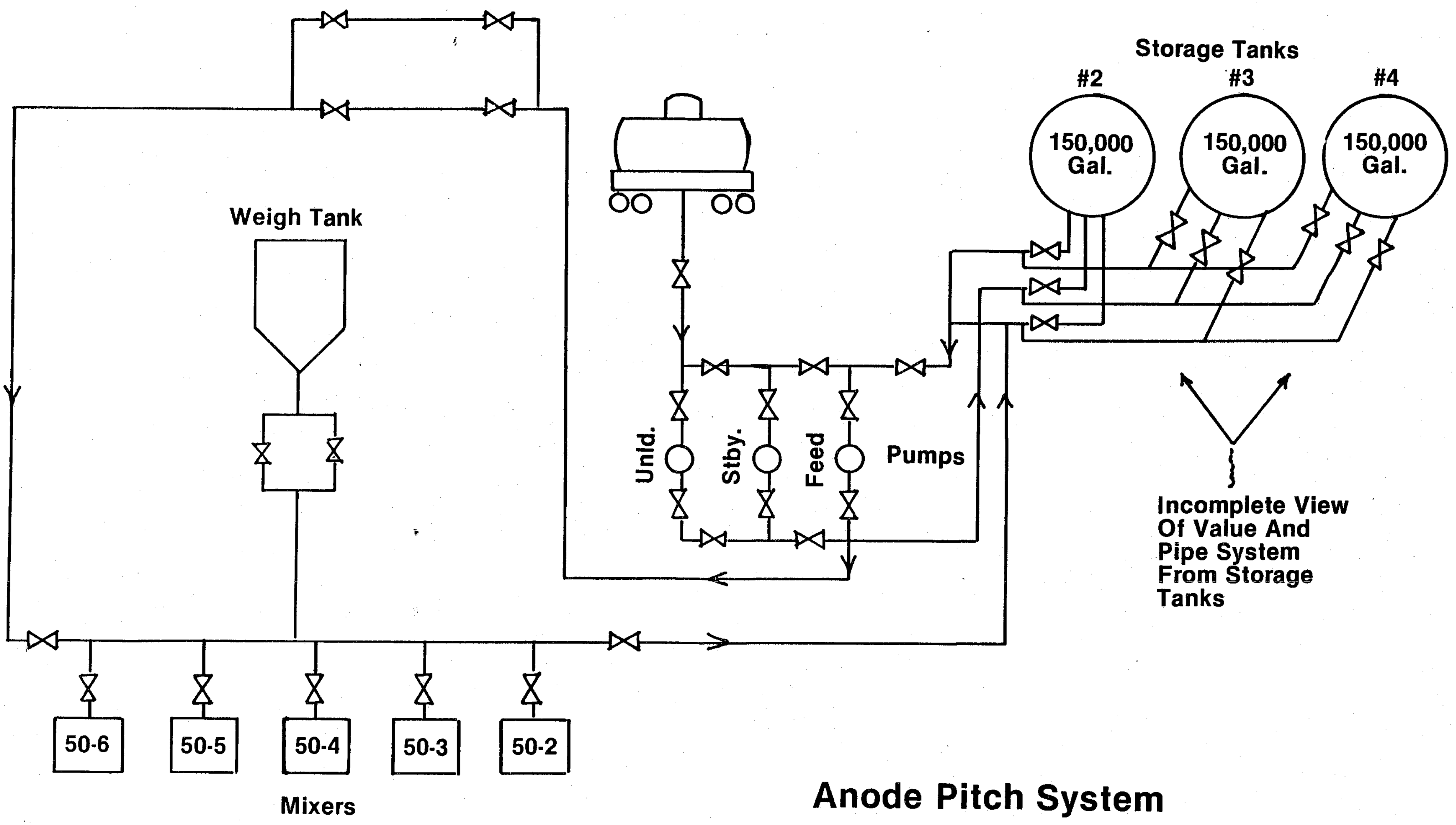
#50	Mixers, 5 each, 4.2-4.5 tons, 75 H.P. 900 RPM (Hot Oil) for higher temperature, Baker Perkins, Signa Blade, Lower 0 20.2 rpm, Upper - 11.9 rpm
#49	Extruder Hoppers, 5 each, 4.5 ton capacity
#52	Extruders, 5 each
#53	Extruder Conveyors, 5 each
#54	Belt Conveyor
#55	Continuous Bucket Elevator
#55A	Continuous Bucket Elevator
#56	Belt Conveyor
#57	Bucket Elevator
#57-1	Belt Conveyor
#57-2	Belt Conveyor
#84-1	Briquette Pit Sump Pump
#84-2	Briquette Pit Sump Pump
	Water Recirculating Pump



Anode Dry Raw Material — Part I



Anode Material — Part II



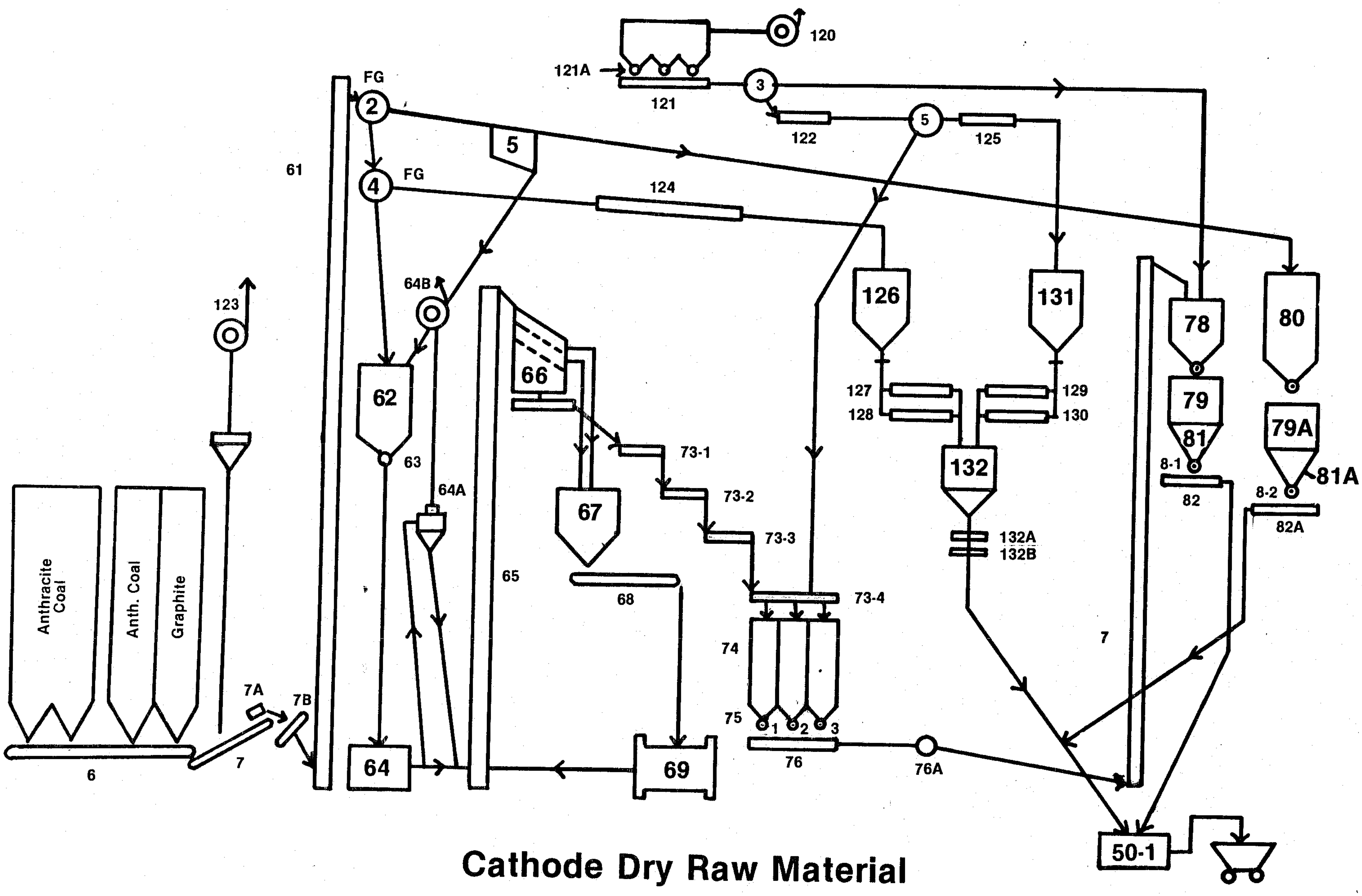
Anode Pitch System

CATHODE DRY RAW MATERIALS

CATHODE DRY RAW MATERIALS

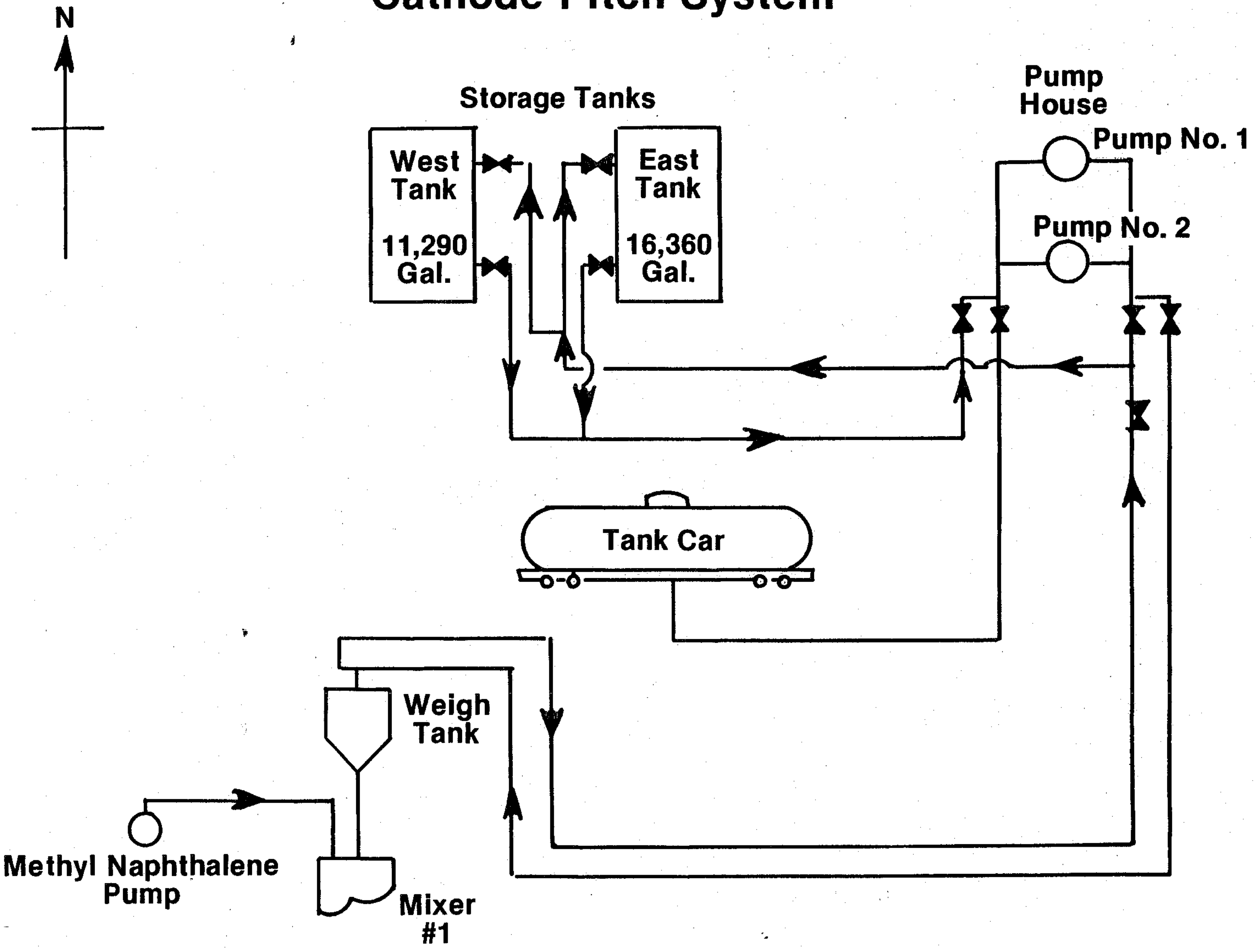
#2	Flop Gate
#3	Flop Gate
#4	Flop Gate
#5	Flop Gate
#6	Belt Conveyor - 10 T/hr - variable speed
#7	Belt Conveyor - 10 T/hr
#7a	Electro-Magnet
#7b	Screen
#50-1	Cathode Paste Mixer - 4.2 - 4.5 ton
#61	Elevator, spaced bucket, 10 T/hr
#62	Anthracite Coal Hopper, dryer feed, 25 Ton
#63	Disc Feeder, adjustable, 2-5 T/hr
#64	Dryer, parallel flow, 5 T/hr
#64a	Dryer, dust control cyclone
#64b	Cyclone Exhaust Fan
#65	Elevator, spaced bucket, 10 T/hr
#66	Screen, two surface, vibrating 1/4" 20 mesh, 10 T/hr
#67	Anthracite Coal Hopper, rod mill feed, 25 ton
#68	Belt Feeder, 2-6 T/hr
#69	Rod Mill, 5 T/hr
#72	Screw Conveyor, 10", 6 T/hr
#73-1 thru #73-4	Screw Conveyor, 10", 6 T/hr
#74	Milled Anthracite Coal Storage Bin, three compartments, 60 Tons total
#75-1 thru #75-3	Rotary Vane Feeder, 6 T/hr
#76	Screw Conveyor
#76a	Magnetic Separator
#77	Elevator, spaced bucket, 6 T/hr
#78	Scale Feed Hopper, 25 Ton
#79	Scale, Duo Screw w/rotary valve
#80	Scale Feed Hopper, 50 Ton
#81	Scale Discharge Hopper, 3 Ton
#81a	Scale Discharge Hopper, 3 Ton
#81-b-1	Rotary Vane Feeder
#81-b-2	Rotary Vane Feeder
#82	Screw Conveyor, 12", 6 T/hr
#82a	Screw Conveyor, 10", 3 T/hr
#120	Fan
#120a	Cathode Dust Control

#121	Screw Conveyor
#121a	Rotary Vane Feeders, 3 each
#122	Screw Conveyor
#123	Fan
#124	Screw Conveyor
#125	Screw Conveyor
#126	Graphite Scale Feed Hopper
#127	Screw Conveyor, 4", scale feed
#128	Screw Conveyor, 9", scale feed
#129	Screw Conveyor, 4", scale feed
#130	Screw Conveyor, 6", scale feed
#131	Anthracite Coal Dust, scale feed hopper
#132	Scale, graphite and dust
#132a	Keystone Gate
#132b	Keystone Gate
#5	Vibrating Screen 1 surface 1/4" mesh



Cathode Dry Raw Material

Cathode Pitch System



REDUCTION CELL

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

VERTICAL STUD SODERBERG CELL		
TYPE OF EQUIPMENT	**EQUIPMENT NUMBER**	**DATE INSTALLED**

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER		**MODEL NO.**	**SERIAL NO.**
P.O. NO.	**P.O. DATE**	**EQUIPMENT COST**	**INSTALLATION COST**

EXTERNAL DIMENSIONS : **LENGTH** ________ **WIDTH** ________ **HEIGHT** ________

INTERNAL DIMENSIONS : **LENGTH** ________ **WIDTH** ________ **HEIGHT** ________

WEIGHT : ________

ELECTRICAL REQUIREMENTS : **VOLTS** ________ **AMPS** ________

UTILITIES : **WATER** ________ **AIR** ________

CAPACITY : ________

PRODUCTION RATE : 1600 lbs. per day per cell

CURRENT RATING : 102,000 Amps

NOMINAL VOLTAGE : 4.9 volts per cell

D.C. KWH : 7.5 D. C. KWH per pound of metal produced

CELLS PER POTROOM : 60

CELL ORIENTATION : Two rows, end to end

LENGTH OF POT ROOM : 10 rooms at 1100 feet

NUMBER OF POT LINES : 5

TOTAL NUMBER OF CELLS : 600

CELL TECHNOLOGY : Anaconda/Pechiney/Sumitomo

ENVIRONMENTAL SYSTEMS : Alcoa 398 Dry Scrubber

ISSUE DATE: 5/82

REVISION: ________

MELTING & CASTING EQUIPMENT

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#3 Mix	Last Rebuild 1969

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER ANACONDA		**MODEL NO.**	**SERIAL NO.**
P.O. NO.	**P.O. DATE**	**EQUIPMENT COST** 130,000	**INSTALLATION COST** 120,000

EXTERNAL DIMENSIONS : **LENGTH** 29' 6" **WIDTH** 12' 6" **HEIGHT** 10'

INTERNAL DIMENSIONS : **LENGTH** ______ **WIDTH** ______ **HEIGHT** ______

WEIGHT : ______

ELECTRICAL REQUIREMENTS : **VOLTS** 220/440 **AMPS** Control & Instruments

UTILITIES : **WATER** ______ **AIR** ______

CAPACITY : TOTAL = 120.5 TAPABLE - 109.7

PRODUCTION RATE : ______

FURNACE TEMPERATURE : ______

BATH DEPTH : ______

WALL LINING : ______

BURNERS : 7,200,000 BTU/hr.

PRESSURE DAMPER : ______

COMBUSTION BLOWER : ______

ACCESSORIES/ SPECIAL FEATURES : Chargewell with cover, water cooled door.

ISSUE DATE: ______

REVISION: ______

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#4 Mix	Last Rebuild 1970

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER ANACONDA		MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 130,000	INSTALLATION COST 120,000

EXTERNAL DIMENSIONS : LENGTH 29' 4" WIDTH 13' 6" HEIGHT 9' 1"

INTERNAL DIMENSIONS : LENGTH 26' 4" WIDTH 10' 6" HEIGHT 6' 11"

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 119.2 TAPABLE - 107.5

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 33" max.

WALL LINING : 85% hi alumina

BURNERS : 7,200,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Chargewell with cover, water cooled door.

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#6 Mix	1979

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER ANACONDA		MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 110,000	INSTALLATION COST 250,000

EXTERNAL DIMENSIONS : LENGTH 29' 4" WIDTH 13' 6" HEIGHT 10'

INTERNAL DIMENSIONS : LENGTH 26' 4" WIDTH 10' 6" HEIGHT 6' 4"

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 118.3 TAPABLE - 93.0

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 32"

WALL LINING : 85% hi alumina & super duty brick

BURNERS : 7,200,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Water cooled door, chargewell with cover.

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#3 Cast	1977

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER	ANACONDA	MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 110,000	INSTALLATION COST 250,000

EXTERNAL DIMENSIONS : LENGTH 23' WIDTH 13' 6" HEIGHT 12'

INTERNAL DIMENSIONS : LENGTH 20' WIDTH 10' 6" HEIGHT 9' 2 3/4"

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 100.4 TAPABLE - 87.4

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 41" max.

WALL LINING : 85% hi alumina

BURNERS : 7,860,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES :

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

REVERB FURNACE	#4 Cast	Last Rebuild June 1982
TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER ANACONDA		MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 110,000	INSTALLATION COST 140,000

EXTERNAL DIMENSIONS : LENGTH 23' WIDTH 13' 6" HEIGHT 10' 8"

INTERNAL DIMENSIONS : LENGTH 20' WIDTH 10' 6" HEIGHT 7' 5"

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 93.9 TAPABLE - 80.6

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 42" max.

WALL LINING : 85% hi alumina & super duty

BURNERS : 7,860,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Water cooled door

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#6 Cast	1979

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER ANACONDA		MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 110,000	INSTALLATION COST 250,000

EXTERNAL DIMENSIONS : LENGTH 26' 3" WIDTH 13' 6" HEIGHT 10' 4"

INTERNAL DIMENSIONS : LENGTH 23' 3" WIDTH 10' 6" HEIGHT 7' 3"

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 107.0 TAPABLE - 76.5

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 37" max.

WALL LINING : 85% hi alumina & super duty

BURNERS : 7,860,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Water cooled door

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#7 Cast	Last Rebuild 1970

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER: ANACONDA		MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 130,000	INSTALLATION COST 120,000

EXTERNAL DIMENSIONS : LENGTH 23' WIDTH 13' 6" HEIGHT

INTERNAL DIMENSIONS : LENGTH 20' WIDTH 10' 6" HEIGHT

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 75 (Norm.) TAPABLE -

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH :

WALL LINING :

BURNERS : 7,860,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Water cooled door

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

REVERB FURNACE	#8 Cast	Last Rebuild 1979
TYPE OF EQUIPMENT	**EQUIPMENT NUMBER**	**DATE INSTALLED**

EQUIPMENT DESCRIPTION & SIZE - **VERTICAL STUD SODERBERG**

MANUFACTURER ANACONDA		**MODEL NO.**	**SERIAL NO.**
P.O. NO.	**P.O. DATE**	**EQUIPMENT COST** 110,000	**INSTALLATION COST** 120,000

EXTERNAL DIMENSIONS : **LENGTH** 29' 6" **WIDTH** 13' 6" **HEIGHT** 9' 8"

INTERNAL DIMENSIONS : **LENGTH** 26' 6" **WIDTH** 10' 6" **HEIGHT** 7' 3"

WEIGHT :

ELECTRICAL REQUIREMENTS : **VOLTS** 220/440 **AMPS** Control & Instruments

UTILITIES : **WATER** ____ **AIR** ____

CAPACITY : TOTAL = 114.7 TAPABLE - 78.7

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 37" max.

WALL LINING : 85% hi alumina

BURNERS : 7,860,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Water cooled door

ISSUE DATE: ____

REVISION: ____

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

TYPE OF EQUIPMENT	EQUIPMENT NUMBER	DATE INSTALLED
REVERB FURNACE	#9 Cast	Last Rebuild 1980

EQUIPMENT DESCRIPTION & SIZE - VERTICAL STUD SODERBERG

MANUFACTURER ANACONDA		MODEL NO.	SERIAL NO.
P.O. NO.	P.O. DATE	EQUIPMENT COST 130,000	INSTALLATION COST 120,000

EXTERNAL DIMENSIONS : LENGTH 29' 6" WIDTH 13' 6" HEIGHT 9' 8"

INTERNAL DIMENSIONS : LENGTH 26' 6" WIDTH 10' 6" HEIGHT 7' 3"

WEIGHT :

ELECTRICAL REQUIREMENTS : VOLTS 220/440 AMPS Control & Instruments

UTILITIES : WATER AIR

CAPACITY : TOTAL = 114.7 TAPABLE - 78.7

PRODUCTION RATE :

FURNACE TEMPERATURE :

BATH DEPTH : 37" max.

WALL LINING : 85% hi alumina

BURNERS : 7,860,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES : Water cooled door

ISSUE DATE:

REVISION:

ARCO ALUMINUM COMPANY

EQUIPMENT DATA SHEET

PRIMARY - COLUMBIA FALLS

REVERB FURNACE	#1 Pig	Last Rebuild July 1980
TYPE OF EQUIPMENT	**EQUIPMENT NUMBER**	**DATE INSTALLED**

EQUIPMENT DESCRIPTION & SIZE - **VERTICAL STUD SODERBERG**

MANUFACTURER ANACONDA		**MODEL NO.**	**SERIAL NO.**
P.O. NO.	**P.O. DATE**	**EQUIPMENT COST** 130,000	**INSTALLATION COST** 120,000

EXTERNAL DIMENSIONS : **LENGTH** 24' **WIDTH** 11' 3" **HEIGHT** 10' 5"

INTERNAL DIMENSIONS : **LENGTH** 21' 9" **WIDTH** 9' **HEIGHT** 6' 8"

WEIGHT :

ELECTRICAL REQUIREMENTS : **VOLTS** 220/440 **AMPS** Control & Instruments

UTILITIES : **WATER** **AIR**

CAPACITY : TOTAL = 92.8 TAPABLE - 77.8

PRODUCTION RATE : 22,000 lbs./hr. production max.

FURNACE TEMPERATURE :

BATH DEPTH : 30"

WALL LINING : Hi alumina fire brick

BURNERS : 5,000,000 BTU/hr.

PRESSURE DAMPER :

COMBUSTION BLOWER :

ACCESSORIES/ SPECIAL FEATURES :

ISSUE DATE:

REVISION:

CASTING EQUIPMENT

STATION NUMBER	No. 3	No. 4	No. 6	No. 7	No. 9
FURNACES SERVED	No. 3 Mix No. 3 Cast	No. 4 Mix No. 4 Cast	No. 6 Mix No. 6 Cast	No. 7 Cast	No. 8 Cast No. 9 Cast
FILTER	Union Carbide	Union Carbide	Union Carbide	B.A.	Union Carbide
* HYDRAULIC CYLINDER CAPACITY	117,810#	117,810#	117,810#	117,810#	169,646#
HYDRAULIC CYLINDER STROKE	218 & 240"	218 & 240"	218 & 240"	218 & 240"	258"
HYRDAULIC CYLINDER DIAMETER	10"	10"	10"	10"	12"
CASTING MACHINE DESIGNER	R.A. NOCK Anaconda	R.A. NOCK Anaconda	R.A. NOCK Anaconda	J.C. OLSON Anaconda	LOMA

PIG CASTER	M.H. Treadwell Company Manufacturer
SIZE PIG	30# and 50#

Capacity

Tons per hour at maximum speed: 11 ton estimate

Speed: 5.5 feet per minute

* @ 1500 PSI on Cylinder (includes crosshead)

Casting cylinders manufactured by:
Vickers, Sawyer & Remco Manufacturing

RECTIFIER STATION AND

SWITCHYARD OPERATION

RECTIFIER STATION AND SWITCHYARD OPERATION

230 KV LINES

The ARCO Plant at Columbia Falls receives its power from the Bonneville Power Administration system. The power enters the switchyard on three lines at the 230,000 volt level. See the potline power schematics which follow this page. The schematics only show the Potline No. 1 and No. 2 areas of the switchyard but they are typical of the rest of the switchyard. Only two of the three incoming lines are shown here. The third line comes from Libby Dam. The switching arrangement is such that the plant can be fed from any one or all the lines, although it takes at least two lines to carry our load of approximatley 372,000 kilowatts.

The 230 KV lines also have a capacitor bank which can be switched in or out. During periods of low voltage these capacitors are usually switched in to bring the voltage back within allowable limits.

The 230 KV to 13.8 KV stepdown transformers are connected to the source voltage through switches. These transformers (shown on Sheet 1 of drawings) change the voltage from 230,000 volts AC to approximately 13,800 volts AC. This lower voltage is easier to handle and control. This plant has seven stepdown transformers, one for each potline and two spares. The transformers are numbered 1 through 7. The following table shows the seven transformers and the potline with which they are normally associated.

Transformer Number	Normally Feeds
1	Potline 1
2	Spare
3	Potline 2
4	Potline 3
5	Potline 4
6	Spare
7	Potline 5

Through switching with disconnects, the spare banks can be used to feed any potline in an emergency.

13,800 VOLT EQUIPMENT

After leaving the stepdown transformer, the power is fed through an electrically operated oil circuit breaker (OCB). In the case of Potline 1, this would be 52-1 OCB. This particular breaker is the dividing line for maintenance between BPA and ARCO. BPA maintains the 52 OCB and all equipment upstream of it. That would include the stepdown transformers, capacitor banks and 230 KV switches. ARCO is responsible for maintenance of all transformers, disconnects and equipment downstream (into the plant) of the 52 OCB's.

The first major piece of equipment that is reached that ARCO must maintain is the regulator. The purpose of these regulators is to control the power being applied to the potline. We have seven regulators numbered one through seven. The regulator corresponds to the stepdown transformer in its numbering, i.e., Transformer 5 and Regulator 5 feed Potline 4, etc. The regulators have two sets of contacts. The major set (no-load taps) determines the approximate range through which the regulator may be operated under load. In order to change from one no-load tap to another, the potline must be dropped (shut off) in order to make the change. Once the load has been dropped, the operator in the Rectifier Control Room can change the taps through remote control. This process normally takes one to two minutes. The other set of contacts are the ones normally used to regulate the load to the potlines within the limits of the no-load tap on which the regulator is set. These contacts draw an arc when they are switched which causes them to wear. For this reason the Operator does no unnecessary taping of the regulators. Excessive tap changing would require excessive contact maintenance on the regulators. The power control achieved by the regulator is not continuous but rather in discrete steps. Each step may change potline DC current from 200 to 1500 amps. The amount of the step is greatly dependent on the relative resistance of the potline (how the line is adjusted).

After leaving the regulators, the power is applied to phase shifting transformers which shift the phase of some of the power so that relatively smooth ripple free DC current can be achieved. The power then leaves the phase shifters and goes to the rectifier transformer. This transformer is essentially a stepdown transformer which changes the voltage from 1,300 volts to approximately 560 volts. This voltage will of course depend on the setting of the regulator. There are eight rectifier transformers in Potlines 1 & 2 and 6 rectifier transformers in Lines 3, 4, & 5. Each rectifier transformer feeds two rectifier frames.

D. C. RECTIFIER EQUIPMENT

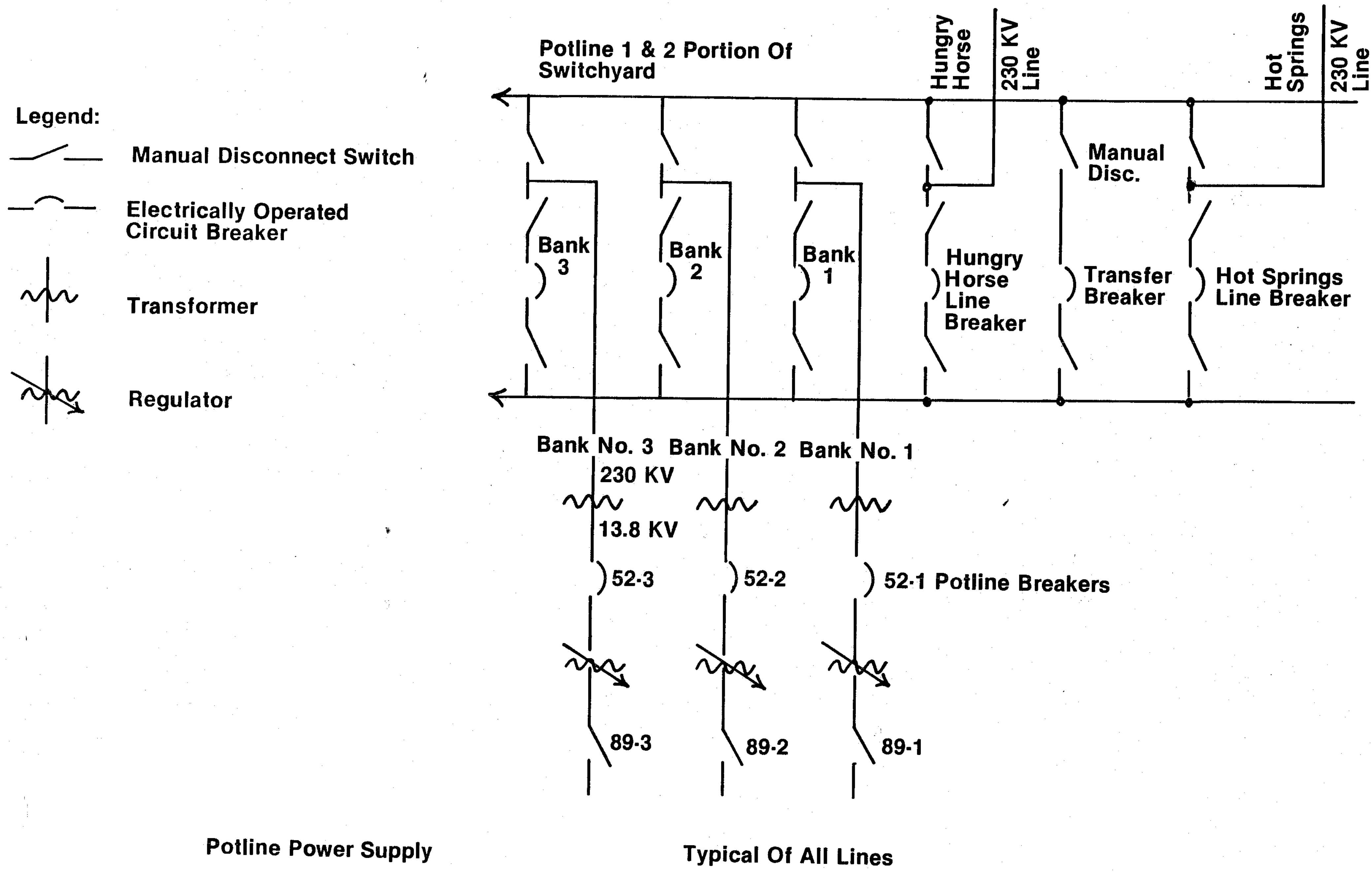
In Potlines 1 & 2, the solid state rectifier equipment was supplied by Westinghouse. This equipment replaced the old mercury-arc converters which had many maintenance problems. The Westinghouse diodes are water cooled and so are dependent on cooling water for operation. In the event of a water failure the operation of the potline would have to be shut down after a few minutes due to heating of the rectifier diodes.

Potlines 3, 4, & 5 have rectifier units manufactured by General Electric. These units are air cooled. The cooling air is supplied by two large blowers pushing air into the cubicles from the basement.

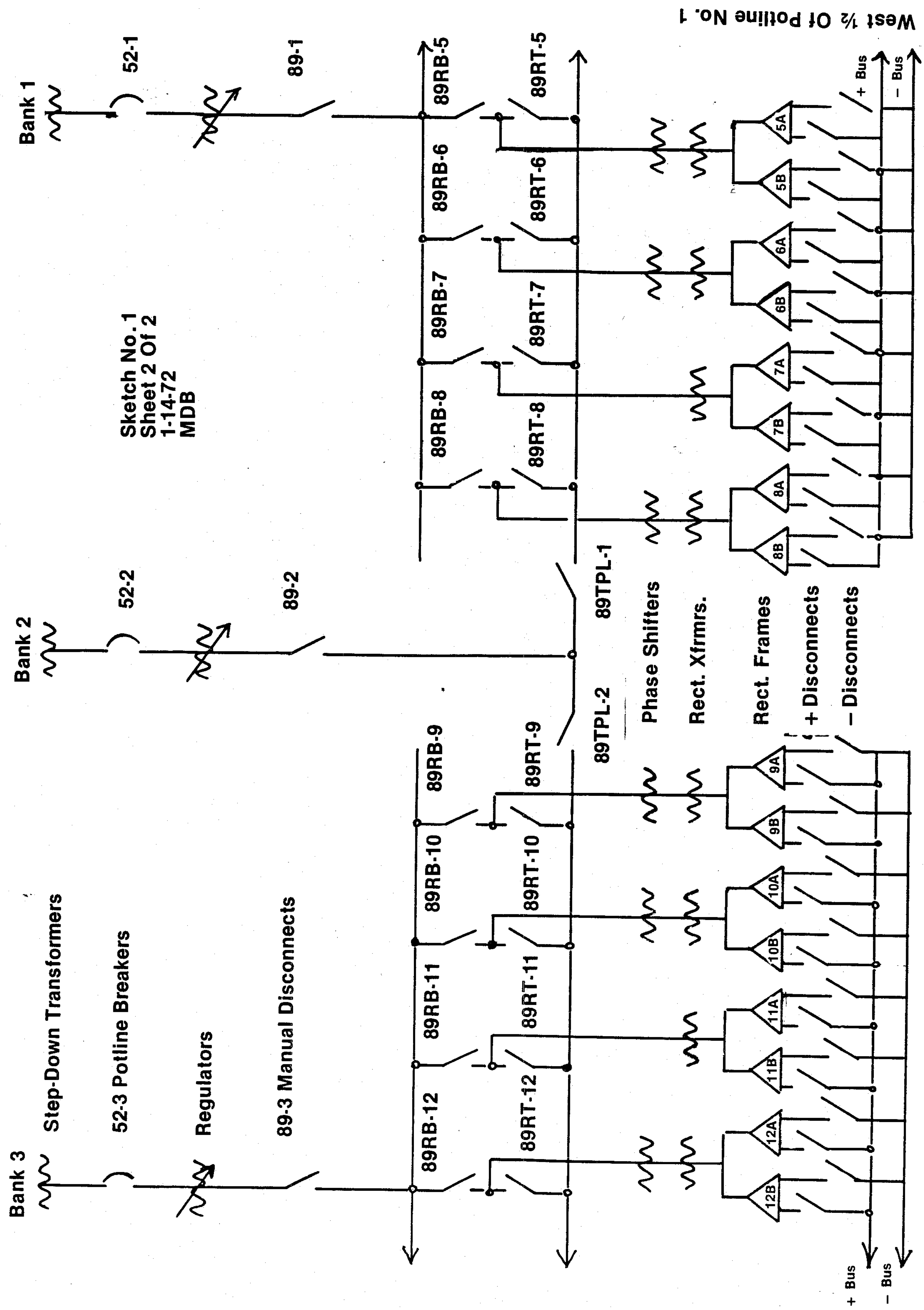
Also individual exhaust blowers on top of each frame draw air through the cubicles. In the event that the cooling air flow is interrupted, the potline would also be shut down in a few minutes due to excessive heat being accumulated in the frame.

All rectifier frames require periodic maintenance. Dirt accumulates on diode insulators creating the possibility of an arc over. Diodes must be checked to make sure that they are carrying their fair share of current, or others in the circuit may be required to pass current in excess of their rating causing them to fail. This is a large job since Potline 3 alone contains 1,584 silicon diodes. The frames also have capacitors. These must be checked for leakage and ability to carry current. If the capacitor fails, it may result in the failure of several diodes. If the capacitor swells up and explodes generating an arc, all the diodes and capacitors in a section of a frame may be destroyed. Tests on other equipment such as fans, motors, pressure switches, etc., must also be performed. For this reason, the normal outage for the maintenance of a set of rectifier frames is about 4 to 6 hours, sometimes longer if trouble is found. Potline current would be reduced during this time in Potlines 1, 2 and 3.

Associated with the rectifier frames are a set of DC disconnects. There are two disconnects for each frame. they are used to isolate the frame from the negative and positive DC buses.



Potline Power Supply


West ½ Of Potline No. 1
Sketch No. 1
Sheet 2 Of 2
1-14-72
MDB
Bank 1
Bank 2
Bank 3
52-1
52-2
89-1
89-2
89RB-5
89RB-6
89RB-7
89RB-8
89RB-9
89RB-10
89RB-11
89RB-12
89RT-5
89RT-6
89RT-7
89RT-8
89RT-9
89RT-10
89RT-11
89RT-12
89TPL-1
89TPL-2
5A
5B
6A
6B
7A
7B
8A
8B
9A
9B
10A
10B
11A
11B
12A
12B
+ Bus
– Bus
Step-Down Transformers
52-3 Potline Breakers
Regulators
89-3 Manual Disconnects
Phase Shifters
Rect. Xfrmrs.
Rect. Frames
+ Disconnects
– Disconnects

ENVIRONMENTAL CONTROL EQUIPMENT

(See Environmental Status Section)

PLANT LABORATORIES

PLANT LABORATORIES

A. Industrial Hygiene Laboratory Certification: The Industrial Hygiene Lab was certified as an accredited laboratory under the Laboratory Accreditation Program of the American Industrial Hygiene Association in 1980. It is the only laboratory in Montana so accredited and is one of only two in ARCO. The other lab is the Anaconda Minerals lab in Tucson. There are approximately 180 labs accredited in the United States.

B. Metallography Laboratory: We have a well-equipped metallography lab. The lab has been heavily involved in evaluating customer service follow-up and in local casting evaluations.

C. Carbon Testing Laboratory: A sophisticated laboratory has been developed for anode and cathode paste mixing, baking and testing, which has allowed us to evaluate raw materials and various formulations of paste prior to production testing.

D. Environmental Laboratory: The plant environmental lab has the capabilities and equipment for all types of required emission and ambient sampling. This lab provides required emission and ambient data for the state and also evaluates dust control and other plant environmental systems. Emissions are measured at the plant roof with an in-house designed continuous sampler which has been accepted by the State Department of Environmental Sciences as an EPA equivalent sampling method. An ambient sequential fluoride analyzer which provides a daily air fluoride concentration reading is also an in-house design which has been in operation in the plant area and in Glacier Park for over 10 years.

RAW MATERIAL AND
HUMAN RESOURCES

ALUMINA CONTRACTS

Alumina is supplied to Columbia Falls under two contracts with Alumax, Inc. The alumina for both contracts originates from either the Kwinana refinery or the Pinjarra refinery operated by Alcoa of Australia in Western Australia. ARCO takes possession of the alumina when it is loaded on board ship at the ports in the Kwinana to Bunbury range and ARCO is responsible for transportation beyond that point.

The first contract calls for delivery of 200,000 metric tonnes per year from January 1, 1975 to December 31, 1990. ARCO may extend this contract four additional years by providing notice to Alumax at least two years before the expiration of the original term. The second contract calls for delivery of 127,000 metric tonnes per year from July 1, 1978 to June 30, 1988. ARCO may extend this contract six additional years by providing notice to Alumax at least two years before the expiration of the original term. ARCO or Alumax may suspend their obligations under these contracts in the event of certain uncontrollable conditions that require the declaration of a force majure.

Price computations for the two contracts are slightly different. The first contract has a fixed charge of $29.23 per metric tonne plus a production charge. Three-fourths of the production charge is escalated according to a weighted index: 35 percent labor rates, 20 percent fuel oil prices, 25 percent iron and steel prices, and 20 percent caustic soda prices. The second contract has a fixed charge of $4.72 million per year plus a production charge. Both the index described above and an index of the producer's actual costs are used to escalate the production charge portion of the second contract.

For billing purposes, 61.16 percent of the alumina in each shipload is deemed to be under the first contract and 38.84 percent is deemed to be under the second contract. Payment terms are net 30 days after the issuance of the invoice for each shipload. Any taxes, royalties, or burdens (other than income tax) imposed on Alumax by the government of Australia or by the government of Western Australia are to be paid by ARCO.

ALUMINA PRICE PER SHORT TON

Year	F.O.B. Price
1977	$111.13
1978	123.58
1979	130.01
1980	151.43
1981	180.63
1982	194.43

Alumina is of the sandy variety and has the following contract specifications:

> No more than 12 percent should pass through a 325 mesh Tyler screen and no more than 10 percent should be retained on a 100 mesh Tyler screen.
>
> No more than 3.5 percent moisture absorption in an atmosphere with 44 percent humidity.

SiO_2	0.040% max
Fe_2O_3	0.040% max
Na_2O	0.700% max
TiO_2	0.006% max
Zn	0.005% max
CaO	0.150% max
V_2O_5	0.003% max
MnO	0.001% max
P_2O_5	0.003% max
Al_2O_3	98.35% min

LABOR CONTRACT

SUMMARY

The labor contract at Columbia Falls is with the Aluminum Worker's Trades Council AFL-CIO and is due for renewal on September 15, 1983. The rates paid craft jobs at Columbia Falls are substantially below the craft rates paid by most other U.S. aluminum producers. Benefit costs are also low compared to other aluminum producers. Work rules at Columbia Falls are not overly restrictive. Wages and benefits at the Columbia Falls plant exceed those paid for comparable jobs in the local community, enabling the facility to attract the most skilled workers in the community.

FURTHER INFORMATION

The average years of service of managerial and professional employees is 15.6 years.

The average years of service for hourly workers is 12.6 years.

The absentee rate is 1.5 percent over the last three years.

1,967,000 man-hours were worked without a lost-time accident from August 27, 1980 through June 22, 1981, establishing a world-wide aluminum industry record.

The rate of lost-time injuries is currently 0.26 per 200,000 manhours versus an industry average of 2.6.

The rate of OSHA recordable events is currently 4.63 per 200,000 manhours versus an industry average of 11.4.

LABOR PRODUCTIVITY AND WAGE RATES

	1978	1979	1980	1981	1982
Manhours per Short Ton for Hourly Employees	12.2	12.7	11.8	9.6	10.6
Average Compensation for Hourly Employees ($/Hr.)	$12.17	$13.10	$14.04	$16.59	$20.00

ELECTRICITY CONTRACT

SUMMARY

Electricity Contract

Electricity is supplied by the Bonneville Power Administration (BPA) under a contract that will expire July 1, 2001. The contract may be cancelled in whole or in part by ARCO with a one-year notice. If ARCO terminates the contract, ARCO will be required to reimburse BPA for the remaining unamortized costs of certain transmission facilities and to compensate BPA for some deficits resulting from lower power demand.

Total electricity available under the contract is 427.5 megawatts; however, because of electrical efficiency improvements in the facility the electricity required when the plant is operating at full capacity is only 346 megawatts. ARCO can increase its electricity to the maximum available with 90 days' notice.

Operating demand for contract purposes is currently stipulated at 216 megawatts. Seventy-five percent of that figure is considered industrial firm power. The other twenty-five percent is also considered industrial firm power, but BPA has greater latitude to vary its supply for specified purposes. ARCO may curtail consumption in the twenty-five percent portion with 24 hours' notice and no penalty, and ARCO may curtail consumption in the remaining portion with 30 days' notice and some penalties* depending upon the degree of curtailment. ARCO can increase the stipulated operating demand with 90 days' notice and can reduce operating demand with BPA concurrence by a notice given prior to April 1 in any year.

The rate charged Columbia Falls and other direct service industrial customers currently includes charges to cover rate relief that BPA provides to residential and agricultural customers of utilities located in the BPA region. After 1985 the rate to direct service industrial customers, such as Columbia Falls, will be based on rates charged industrial customers of public agency utilities in the region. The rate to direct service industrial customers is currently about 26 mills per kilowatt hour.

Rate Setting Evironment

The electricity rate to direct service industrial customers increased 23 mills from 1979 to 1983. The two main reasons for the increase were new charges to cover the subsidies

* Penalty is 40% of demand rate. If curtailments are extensive enough, the penalty becomes first 90% and then 100% of the demand rate.

Rev. 3/15/83

mentioned above and new charges to cover the construction of electricity generating plants.

One coal-powered plant and a nuclear plant were constructed by investor-owned utilities under an arrangement where BPA purchases all the electricity generated by these plants. The higher cost of this new electricity is included in current rates. The Washington Public Power Supply System also began construction of three nuclear plants under similar arrangements where BPA would purchase all the electricity from two plants and 70 percent of the electricity from the third. Current electricity demand forecasts indicate that these plants will not be needed. Plans are to mothball one and complete construction of the other two.

In addition, the Washington Public Power Supply System began construction of two more nuclear plants to supply electricity to 88 public agency utilities that guaranteed the bonds to finance these projects. Construction on both of these plants has been terminated.

Several suits are pending concerning the validity of the BPA contracts with direct service industrial customers, the validity of BPA electricity rates, and the distribution of costs related to the unfinished power plants.

ELECTRICITY SUPPLY

I. THE PACIFIC ELECTRIC POWER PLANNING AND CONSERVATION ACT.

The Pacific Northwest Electric Power Planning and Conservation Act dated December 5, 1980, reaffirmed the intent of the United States government to help the Pacific Northwest with its electrical power suply problems. Federal Government involvement in the Pacific Northwest Electric matters began in the 1930's under a program of cooperation with regional utilities as an effort to develop the hydro-electric potential of the Columbia River system. Since that time 30 multipurpose dams on the Columbia Rivers and its tributaries have been built by the U.S. Army of Engineers and the Bureau of Reclamation (now the Water and Power Resources Service). Investor owned and publicly owned utilities have also built a major system of dams and generating facilities. Congress directed the Bonneville Power Administration in the Bonneville Project Act of 1937 to build and operate a transmission system to delivery the power from dams and to market electricity from federal generating projects on the river at rates set only high enough to repay the federal investment over a reasonable period of time.

In the early 1960's the government of Canada was involved in a treaty with the United States in a cooperative effort to use the dams built by Canada on the upper regions of the Columbia River. The Canadian dams provide flood control as well as reservoir storage for the production of additional reliable power at the U.S. dams downstream.

Also in the 1960's Congress authorized the construction of 3 major power transmission lines which now link the Columbia River hydro-electric projects with power markets in the Pacific Southwest. These lines have been used to sell surplus hydro-electric energy from the Northwest when it is not needed and would otherwise be lost in the form of water spilled over dams and also as a means of importing needed electricity from teh Southwest during times of Northwest drouth.

With the dams built in the Pacific Northwest and the additional capacity gained from the treaty with Canada, the Columbia River system provided virtually all the electricity needs of the Pacific Northwest until the early 1970's. By that time all of the economical dam sites on the main steam of the Colubmia were either developed or under development and the region was looking for other ways to meet electric load growth. Shortages of electricity threatened the region unless thermal generating plants were brought on line in response to increaseing demand. The Bonneville power administration joined with the utilities in the Northwest in participating in a hydro-thermal power plan for the continued development of electricity resources in the Pacific Northwest. Under this plan BPA agreeded to acquire electricity by entering into (net billing) agreements with its publicy owned utility customers. These agreements made it possible for the publicy owned utilities to begin construction of 3 nuclear power plants in Washington state and to meld the higher costs of these plants with the lower costs of federal hydro-power to reduce the risk and rate disparities of individual utility systems. The investor owned utilities constructed 1 coal fired generation plant and 1 nuclear power plant as a part of this program. In spite of the efforts BPA and the regions utilities made to continue developing the regions generating resources in a systematic way, load forecasts in the early 1970's continued to indicate that demand for electric power was growing at a faster rate that could be met under the hydro-thermal power program. Revised regulations by the Internal Revenue Service and the increasing costs of coal and nuclear power plants prevented the expansion of that program and led to the development of a plan in which the utilities would finance their own plants without the net billing assistance by BPA. The consumer owned utilities began the construction of 2 additional nuclear power plants under this plan. Those plants have since been terminated because lower demand forecasts in recent years indicate they will not be needed in the immediate future.

The Bonneville project act of 1937 directed that cooperatives and publicly owned utilities of the region be given first call on available federal electricity resources. They consequently came to be called "preference customers" of BPA. Until recently, their legal preference for federal power had never been exercised because there had been enough electricity to serve their needs as well as the needs of the investor owned utilities and the industries that were served directly from BPA (The Direct Service Industries or DSI's). In 1973 when BPA's firm power contracts with investor owned utilities expired BPA would not offer new ones if preference customers were to continue to have first call on federal resources. So the firm power contracts with investor owned utilities were not renewed. Contracts that were then in effect for the DSI's were due to expire in the mid 1980's. By 1976 BPA's power demand and supply projections showed that federal power supplies were running short for preference customers and that BPA would no longer be able to guarantee preference customers that their load growth could be met beyond 1983. BPA then issued a notice of insufficiency to the preference utilities and informed DSI's that their contracts would not be renewed when they expired.

With the investor owned utilities relying on their own resources to meet growing demands and the consumer owned utilitites still able to receive the lower cost federal hydro-power a divisive struggle for access to federal resources grew. Sixty percent of the residential and farm customers of the region were served by the investors owned utilities. These customers were paying about twice as much for electricity as customer of consumer owned utilities receiving power from BPA. The city of

Portland sued BPA claiming a right to share the federal hydro-power resources and the State of Oregon passed a law authorizing the formation of a state wide public utility to gain access to the low cost federal power. Elected officials in Washington, Idaho and Montana also talked of forming their own state wide public utilities. THere was also a resurgence of activities to form new consumer owned utlities to buy out investor owned utilities in certain areas.

During this "post insufficiency notice" period the region continued its historical pattern of working toward a cooperative solution that preserved local options while obtaining regional efficiencies of intergrated electric systems. Despite these efforts, massive legal battles were foreseen and no regional solutions were found. A cooperative effort was begun to inact new federal legislation.

After 3 years of deliberation and hearings a method was devised for protecting the preference which existed for the consumer owned utilities while at the same time providing the benefits of federal hydro-ower to the residential and farm customers of private utilities and insuring new reliable long term power contracts would be made available to the regions directly served industrial customers. The Pacific Northwest Electric Power Planning and Conservation Act (P.L. 96-501) was passed on December 5, 1980.

Under public law 96-501, a regional planning council was formed with 2 representatives from each of the Northwest states. The council has the responsibility of developing a plan for meeting the electrical needs of the region while taking into account the social and economic effects of alternate courses of action. The Bonneville power administration is still responsible for meeting the loads of customers and managing the federal facilities in the Pacific Northwest. BPA was given the additional authority to purchase the generating capabilities of new power projects, but only after determination that they are required in addition to all cost effective conservation activities. The supply preference to the consumer owned utilities by previous federal law was protected under this law. The full future requirements of the consumer owned utilities can now be met by BPA. The residential and farm customers of the investor owned utilities were granted rate relief. These utilities now are authorized to sell to BPA at their average power cost an amount of energy equal to their residential and farm loads. Bonneville sells to them in return enough energy at BPA's lowest rate to cover these residential and farm loads. The Direct Service Industries including ARCO Aluminum received new 20 - year power contracts from BPA but at a higher price than was being paid prior to the new law. Prior to 1985 these industries will pay a portion of the net cost of the rate relief to the residential and farm customers of the investor owned utilities. After 1985 the DSI power rate will be based on the retail rates charged by the consumer owned utilities to their industrial customers in the region.

In addition to the general discussion of public law 96-501 above, there are some specifics which are important to the operation of ARCO Aluminum's Columbia Falls plant:

1. Bonneville was authorized to sell electric power to existing Direct Service industrial customers only, and only in amounts that were previously committed under prior contracts. Fifteen Direct Service industrial customers were identified as qualifying for new BPA contracts. These companies are listed in Table 1. New large industrial loads of the consumer owned utilities must pay higher rates that existing customers under the act. Placing a restriction on the addition of new DSI's and higher rates for a new industrial customers of the consumer owned utilities serves to limit the growth of electrical load and insure that rates for those existing customers such as ARCO Aluminum will be kept at a lower level.

2. The act also directed BPA to grant billing credits to a customer for conservation activities independently undertaken or continued after the effective date of this act. ARCO Aluminum completed a 42 million dollar modernization program in 1981 which reduced the electrical power requirements of the plant by increasing its electrical efficiency. Although BPA has not yet finalized its billing credits procedure, we believe that ARCO Aluminum is entitled to some monitary credits from BPA for this conservation program.

II. POWER SUPPLY CONTRACT

Following the passage of public law 96-501 BPA began negotiations on new long-term power sales contracts with its utility and industrial customers. ARCO Metals Company (at that time Anaconda Aluminum Company) actively participated with the other DSI's in those negotiations which lead to the offering of a contract on August 28, 1981. ARCO signed the offered contract on August 31, 1981.

The term of the contract is 20 years commencing of July 1, 1981, however, it may be cancelled in part or in whole by ARCO with a one year notice. In the event of terminate ARCO is required to reimburse BPA for the otherwise unrecoverable costs incured because of the termination which have been defined for a termination prior to 1987 as the unamortized investment in transmission facilities constructed to serve the plant and the obligations that ARCO has under Section 7 (b) (3) of public law 96-501. These 7 (b) (3) payments if any, can not be quantified at this time because BPA is undergoing a public process for developing the methodology to be used. These payments were established by the law to compensate for BPA deficits prior to 1985 because of lower DSI loads that anticipated.

Under the contract ARCO purchases a grade of power know a industrial firm power. The upper limit of the amount of power available is set by the Contract Demand which is 427.5 megawatts for ARCO. This Contract Demand level gives considerable flexibility to ARCO since our actual plant demand has been lowered due to the efficiencies resulting from our plant modernization. Unlike most of the other Direct Service industrial customers, ARCO has an opportunity to expanded its operations using more BPA power.

The actual electrical demand level for contract administration is established by designating an Operating Demand which is then divided into four equal parts or "quartiles". BPA is required to plan firm energy resources to meet 3 quartiles of ARCO's load along with the other DSI's. The top quartile is to be served from non-firm resources.

ARCO can increase its Operating Demand up to the level of the Contract Demand by giving BPA 90 days notice and can reduce its Operating Demand with BPA concurrence by a notice given prior to April 1st in any year. This flexibility is important when considering the ability to increase or decrease plant production at minimal power costs.

BPA has the right to restrict (reduce) specified amounts of Operating Demand for cetain periods of time for specific reasons. In general, BPA can restrict deliveries of the top quartile of Operating Demand at any time for any reason in order to protect Bonneville's ability to meet its firm obligations. Bonneville is not obligated to plan for or acquire resources for the purpose of serving this top quartile load, but BPA will treat the top quartile as a firm load for the purposes of resource operation. Bonneville may also restrict deliveries to the second quartile if Bonneville can not meet its firm obligations due to a shortage of power caused by a delay or unexpectly poor performance of a new generating resource. Bonneville may restrict more of the Operating Demand for shorter periods of time if necessary to maintain its system stability, or if necessary to recover amounts of energy previously borrowed to serve the top quartile that must be returned to meet Bonneville's other firm obligations.

Even though BPA is allowed to restrict deliveries to ARCO, Bonneville is obligated to take certain actions to achieve the highest possible availability of industrial firm power consistent with the treatment of the first quartile as a firm load for purposes of resource operation to the extend that this load can be met without deminishing the level of protection of all BPA's firm obligations. Bonneville will provide first quartile service through the use of techniques and rights enabling BPA to move firm load and firm power between periods of time. Operating agreements or annual operating plans are contemplated in the contract that will delineate the specific techniques to be used in order to make top quartile power available.

In addition to our right to lower Operating Demand, ARCO has the right to curtail loads given proper notification. If ARCO has not agreed to purchase energy for its top quartile through one of the techniques previously discussed, ARCO may curtail the top quartile of Operating Demand by giving 24 hours notice with no penalties. Curtailments below the top quartile are allowed by giving 30 day notice and some power penalties* will result depending upon the degree of curtailment. ?

The basic terms of ARCO's BPA power sales contract are the same as those for other industrial customers except for minor differences relating to delivery point facilities. If BPA offers to enter into a written amendment of any other DSI power sales contract, BPA will offer a corresponding amendment to ARCO.

III. CURRENT POWER SITUATION

When the Pacific Northwest Power Planning and Conservation Act was being debated in Congress the Pacific Northwest faced a serious threat of electric energy shortages. One of the purposes of the act was to provide a workable and cost effective mechanism for alleviating prospective power shortages. Since 1980 the power supply situation has changed dramatically. Instead of facing shortages the Northwest faces surpluses in firm energy even under the worst hydro-electric water conditions on record. BPA's energy resources for the 1982 - 1983 operating year total slightly over 9,000 megawatts under poor streamflows. This is slightly less than half of the energy capability in the region, but BPA will have proportionatly more energy available than other utilities in the region during normal streamflow conditions because of the number of dams it controls on the main stream of the Columbia River.

The dramatic change in the balance between the regions loads and resources coupled with expectations for lower than historical demand growth have already brought about major changes in te Pacific Northwest. The Washington's Public Supply System (WPPSS) which has been building 3 nuclear power stations which were net billed under the hydro-thermal power program and 2 additional nuclear power stations financed by consumer owned utilities has terminated the independently financed plants and deferred one of the net billed plants. Portland General Electric Company has withdrawn its site application for the Pebble Springs nuclear project and a decision to proceed with construction of th Skagit project of Puget Sound Power and Light Company has been deferred. The Washington Public Power Supply Systems decision in January 1982 to terminate its nuclear projects 4 and 5 caused considerable controversy in the region. The 88 consumer owned

* See comments noted at p. III-4

utilities that participated in these projects now face repayment of 2.25 billion dollars in bonds with no prospect of producing power to help pay for the obligation. Rate increases which have been proposed by some of the sponsor's of projects 4 and 5 in their service territories are being resisted and rate payers have organized to sue utilities, utility commissioners, the Washington Public Power Supply System and others in an attempt to repudiate the debt. Other legal actions concerning these plants will be discussed in a later section of this document. Rates for electric power in the Pacific Northwest have increased rapidly in the past few years. Power prices that averaged under 5 mills per kilowatt hour to the consumer owned utilities and less than 3 mills per kilowatt hour to the large, high load factor, Direct Service Industries until 1979 have increased to about 18 mills per kilowatt hour for the consumer owned utilities and 26 mills per kilowatt hour for the Direct Service Industries today. The reasons for the general increase in electric rates are primarily the high costs associated with the construction of the Washington Public Power Supply Systems nuclear projects as compared with the very low cost existing hydro-electric system. Just as important, however, to ARCO Aluminum and the other Direct Service Industrial customers have been the impacts of rate adjustments made to industrial rates to comply with public law 96-501 and the 1981 BPA power sales contracts. These drastic rate incrases have not gone unchallenged and several cases now are before the Federal Energy Regulatory Commission and the Ninth Circuit Court dealing with the increases since 1979. ARCO and the other Direct Service industrial customers continue to be deeply involved in these cases because we believe that the present high industrial rate is not justified under the law.

The Pacific Northwest Electric Power and Conservation Planning Council (Northwest Power Planning Council) was created on April 28, 1981 in accordance with Public Law 96-501. Since that time the council has hired a staff, established a central office in Portland, Oregon, released a fish and wild life program and has completed several major studies designed to produce state-of-the-art energy forecasting computer models. These models are being used to prepare a regional energy plan. The draft plan is expected in February 1983 with final adoption by April 28, 1983. This plan will be used by BPA as a guide to meeting its responsibilities for providing an adequate electric power supply while stressing conservation methods and minimizing the impact on the environment.

A status report of current power related litigation that might impact the Columbia Falls operation follows:

A. <u>Contract Litigation</u>

1. <u>Central Lincoln PUD v. Johnson (I).</u> In this case, the Court of Appeals for the Ninth Circuit found the DSI contracts to be invalid because BPA improperly allocated

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nonfirm power to serve the DSI top quartile ahead of claims on the power by preference customers. Rehearing has been denied. A petition for certiorari must be filed by Christmas with the Supreme Court. Our attorneys have circulated a first draft. The DSI's are trying to persuade the Department of Justice to file a similar petition in behalf of BPA. Bonneville has offered the DSI's a contract amendment to make the contracts valid.

2. ALCOA, PPC, PPL v. Johnson. These cases involved utility challenges to the DSI contract and DSI challenges to utility contracts (Section 8 (1) of the general contract provision). From our perspective the issue was whether all our load would bear exchange costs or only three quartiles. The cases were tentatively settled last spring and summer. The settlement has now become final.

3. Lloyd Marbet v. BPA. The Ninth Circuit has ruled that this NEPA suit may proceed before it although, in our opinion, it was untimely filed. Representatives of each customer class have moved for a reconsideration. Meanwhile there is pending before the Ninth Circuit Marbet's appeal of the dismissal of the same claim from the District Court.

4. California Energy Comm'n v. Johnson. This suit challenges various contract provisions of NEPA grounds. The object of the Commission is to assure a long-term source of power for California. Further proceedings in the case have been suspended while BPA tries to effect a solution to the California problem.

5. Seattle v. Johnson. This suit sought to set aside BPA's 1976 Notice of Insufficiency so that the preference utilities would not have to sign new contracts. The Ninth Circuit refused to extend the deadline for signing last August. The result was that the prominent plaintiffs (including Seattle) signed new contracts and dropped the suit. BPA is attempting to settle with the remaining six small utilities.

6. National Wildlife Federation v. Johnson. This suite challenged the Alumax contract. It has been settled.

B. Rate Case Litigation

7. Central Lincoln PUD v. Johnson (II). This suit challenges the 1981 BPA rates. The Ninth Circuit has said it wants to hear the merits of the case although most parties argue that the court does not have jurisdication until final FERC approval of these rates. Oral agrument is set for December 17, 1982.

8. Kaiser v. Johnson. This suit challenges the 1982 rates. the case is in its preliminary stages. Although we believe that FERC has initial jursidcation (see comment 7) the suit had to be filed in case we are wrong.

9. FERC Proceeding. The 1979, 1981 and 1982 BPA rates are still pending before FERC for final approval. A prospective settlement in the 1979 case has fallen apart. FERC has said that it does not have jurisdiction to review rate design under the Act. This affects the 1981 and 1982 rates. Nevertheless, FERC does have jurisdiction to review the setting of rates out of the region. If has not begun hearings on this issue yet.

C. WPPSS Litigation

10. City of Springfield (I). In this case the Oregon irate rate Payers sued to invalidate the obligation of the Oregon participants in WPPSS 4 & 5 to pay the costs of termination. The Oregon Circuit Court found that entering the agreement was beyond the power of the Oregon participants. The court did find, however, that they were not fraudulently induced as part of a conspiracy to build the plants to serve the DSI load. The case is being appealed.

11. City of Springfield (II). The city has sued in federal court for a declaration of its obligations under the WPPS 1, 2 and 3 agreement. If, it asks the Oregon court was correct, should not the same reasoning apply to its other WPPSS obligations.

12. Chemical Bank. In this suit, the state court in Washington ruled preliminarily that Washington participants were obligated under the WPPSS 4 & 5 agreements. The Departement of Justice, in discovery proceedings, took the position that federal documents were not subject to discovery in state court. It intended to try that issue in federal court. Through error, it removed the entire case to federal court. Justice is now trying to get the case back to state court.

13. PUDs v. BPA. This suit was filed last week in the Court of Claims. It charges that BPA violated preference rights by entering into contracts with DSI's and then issuing a notice of insufficiency. This forced the PUD's to participate in WPPSS 4 & 5. They seek damages equal to their obligations (if any) arising out of the terminated plants.

14. Cost-Sharing Suits. These revolve around what, if any, portion of costs shared by terminated and nonterminated WPPSS plants must be borne by the nonterminated plants.

D. Miscellaneous

15. Coalition v. Oregon PUC. In this case Lloyd Marbet is attacking the Oregon Commissioner's decision in a PGE rate increase case. Marbet claims that costs of terminated Pebble Springs are being passed on to rate payers. We would like to support Marbet to exclude such costs from PGE's average system costs. On the other hand, we want to defend the Commissioner's revenue requirement settlement as we were a party to it. At some point the DSI's may intervene.

IV. FORECASTS OF RATES AND RELIABILITY

In the mid 1960's demand for electrical energy in the Pacific Northwest was growing at a compound rate of about 6½% per year. Because the region's utilities could see that the hydro-electric potential in the Pacific Northwest had been almost completely developed, many new coal and nuclear power plant projects were begun to meet the expected load growth. Although initial forecasts indicated that the price of power from these new thermal power plants would not be drastically different from the existing hydro-electric power system, circumstances changed and by 1979, BPA needed almost $200 million to begin paying for the net billed plants that were not yet operating. By 1981 that figure had increased to almost $280 million and by 1982 the figure was $628 million. The 1982 figure represents almost 30% of BPA's total revenue requirement and no power is being generated yet to produce revenues from these projects. At the time that electric rates were going up rapidly, forecasts for future demand were going down and the need for these projects was lessening. Regional electric forecasts released in 1982 range from a high growth rate of 2.5% per year to a low of 1.6% per year.

The changes outlined above have caused considerable problems for Pacific Northwest utilities and their rate payers in the immediate past. There is reason to believe, however, that the Northwest is now entering a period of adequate electrical power supply and stable prices. Decreasing load forecasts indicated that fewer expensive thermal power plants will be needed. Power plants that were recently terminated cause immediate problems but alleviate large future problems. In an address in Portland, Oregon on September 20, 1982, Peter Johnson the Bonneville Power administrator stated that the Pacific Northwest is entering a new area of stability. "This new era will be marked by stable electricity prices, adequate power supplies and development of conservation as a main line resource", Johnson said in an address to BPA wholesale power customers. "The worst of the rate increases are behind us. By 1985, rates will hold steady as a proportion of consumers spendable income" he said. "The price of electricity here in the Pacific Northwest will remain very competitive on a national basis, preserving the economic benefits of low cost hydro-power long into the 21st century." During this address Johnson stated that most of the costs associated with regional thermal plant projects are now reflected in rates and that the Pacific Northwest can look forward to a period of moderate rate increases until 1985. By 1985 rates adjusted for inflation will level. He also said that rising costs associated with the Washington Public Power Supply systems nuclear projects are now under control and that for the first time a supply system is projecting lower costs.

Peter Johnson's statements are even more valid for ARCO Aluminum and other Direct Service industrial customers than for the region as a whole. Because power supplies to ARCO and the other industries is partially interruptible, adequate power supplies mean that fewer interruptions will occur and that there will continue to be pressure for consumption of surplus power suplies which will tend to hold down the rates for industrial power. A major hurdle will be crossed in 1985 when the basis for the Direct Service industrial customer rates will change according to law. After 1985 the industrial group will no longer continue to provide the direct subsidy for residential consumers of investor owned utilities. As that time rates will be based on rates by industrial customers of BPA's consumer owned utilities. This will make ARCOs rate competitive in the region, and that rate should also be competitive in the United States since BPA still can rely on its capability of producing at least 9,000 average megawatts of low cost hydro-electric power which will not escalate at normal inflation rates, and the costs of the net billed thermal plant will be stabilized and should also increase at moderate rates.

The legal cases which are now prevalent in the Northwest should be resolved in the near future which will make it possible to once again solve regional problems in a cooperative and positive manner.

IV. COMPARISON WITH OTHER SMELTER LOCATIONS

According to a report issued by the International primary Aluminum Institute the power costs for smelters in the world vary today by a factor of 20 between 3 and 60 mills per kilowatt hour. The average power cost for all IPAI smelters was reduced from 18.5 to 17 mills per kilowatt hour last year because of the closing down, mainly in Japan, of more than 500 thousand tons of smelter capacity with the most expensive power. The report goes on to say that for almost all the smelters in the industrialized

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countries the cost of electric power is going up further, which we must accept as an irreversible trend. The reason is: New power plants are much more costly than the previous generation.

In North America power costs differ from those world wide as would be expected. We estimate that the 1983 U.S. weighted average power cost is approximately 27.9 mills per kilowatt hour. This can be compared to the 26.7 mills per kilowatt hour figure estimated for the Columbia Falls plant.

Within the United States there are 5 geographical areas containing all of the U.S. smelter capacity. The Pacific Northwest has approximately 1.6 million tons of annual capacity at a 1983 cost of about 26.7 mills per kilowatt hour. The Tennessee Valley area has about 900 thousand annual tons of capacity at an estimated average cost of 32.4 mills per kilowatt hour. The Ohio Valley has almost 1.5 million tons of annual capacity at an average cost of 28.2 mills per kilowatt hour. The Northeast has 350 thousand tons of annual capacity at an estimated cost of 10.2 mills per kilowatt hour; and, the Gulfcoast has 533 thousand tons of annual capacity at a cost of about 35.0 mills per kilowatt hour. These figures indicate that the Pacific Northwest area including ARCO Aluminum is currently not in a strong position from the power cost standpoint. This situation will change, however, as the Pacific Northwest rates are expected to increase at a slower rate than any of the other areas with the exception of the 2 plants in the Northeast. By 1995 we expect power rates form BPA to its industrial customers will be approximately 49.7 mills per kilowatt. hour. In the Tennessee Valley with power costs that escalate with the price of coal fired and nuclear generation, we expect rates to be approximately 74.4 mills per kilowatt hour. In the Ohio Valley where all of the capacity comes from coal fired power plants we expect a cost of about 55.8 mills per kilowatt hour. The Northeast with its hydro-electric base will only escalate to about 16 mills per kilowatt hour. The Gulf Coast with a mixture of coal, nuclear and some natural gas will escalate to about 72.3 mills per kilowatt hour. These estimates are shown in Figure 1.

By 1995 the U.S. weighted average cost will be about 56.6 mills per kilowatt hour. This will once again make the Pacific Northwest smelters including ARCO Aluminum very competitive in the U.S. market.

Figure 2 shows a range for future BPA rates to its industrial customers. In addition to most likely case using latest projections of inflation, a high and a low case have been projected using different assumptions of loads and costs. A "worst case" has also been projected using higher inflation rates and assuming that none of the nuclear plants being built by the Washington Public Power Supply System ever operate.

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TABLE 1

Direct Service Industrial Customers

1. Aluminum Company of America, Addy, Wenatchee and Vancouver, Washington,
2. ARCO Aluminum Company, Columbia Falls, Montana.
3. Carborundum Company, Vancouver, Washington.
4. Crown Zellerbach Corporation, Port Angeles, Washington.
5. Georgia Pacific Corporation, Bellingham, Washington.
6. Hanna Nickel Smelting Company, Riddle, Oregon.
7. Intalco Aluminum Company, Ferndale, Washington.
8. Martin Marietta Aluminum, Inc., Goldendale, Washington, and Trentwood, Washington.
9. Kaiser Aluminum and Chemical Corporation, Mead, Tacoma, and Trentwood, Washington.
10. Oregon Metallurgical Corporation, Albany, Oregon.
11. Pacific Carbide and Alloys Company, Portland, Oregon.
12. Pennwalt Corporation, Portland, Oregon.
13. Stauffer Chemical Company, Silver Bow, Montana.
14. Union Carbide Corporation, Portland, Oregon.
15. Alumax, Inc., Umatilla, Oregon.

FIGURE 1

ELECTRIC POWER RATES

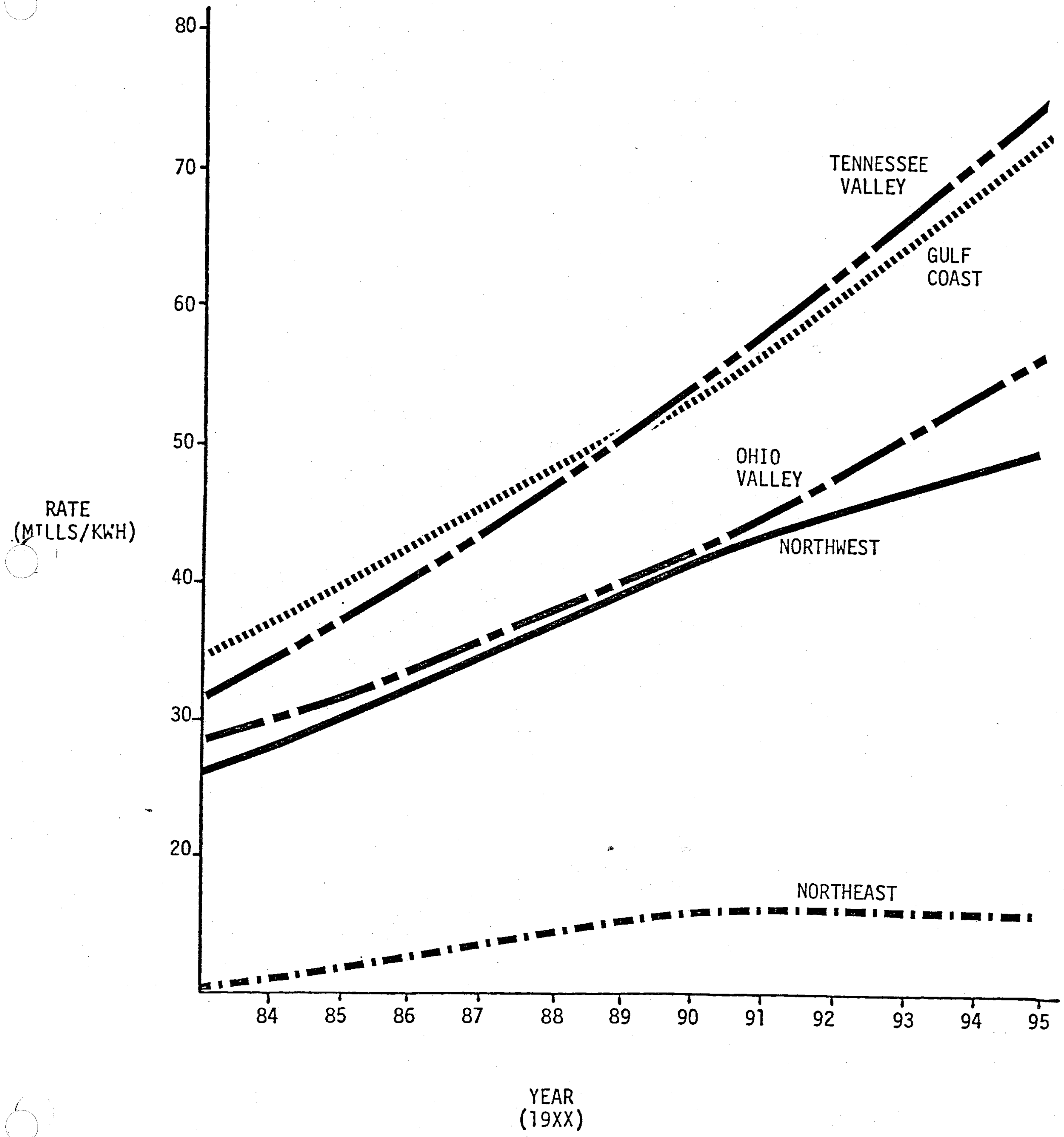
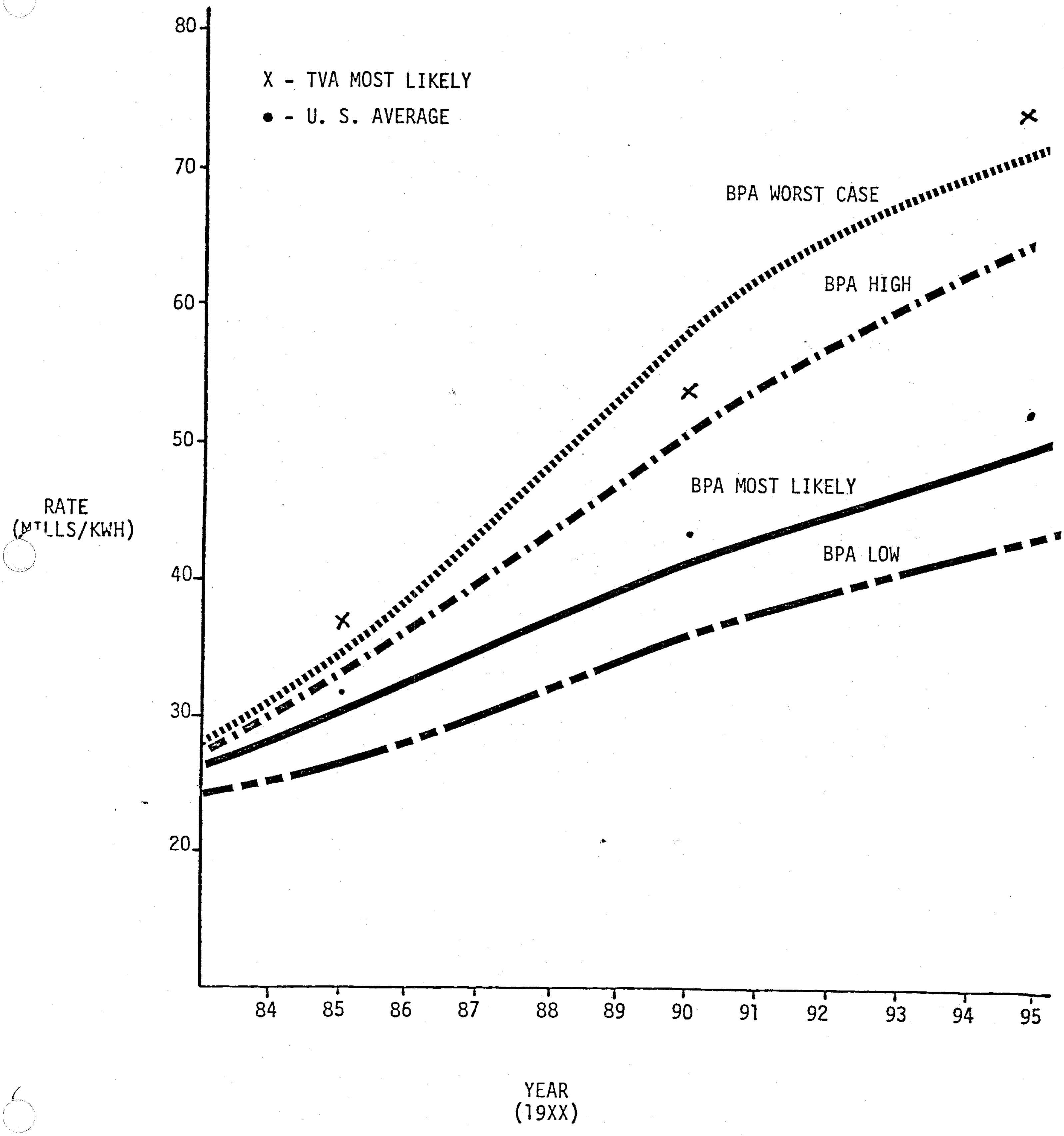


FIGURE 2

ELECTRIC POWER RATES



ENVIRONMENTAL STATUS

ENVIRONMENTAL STATUS

AIR QUALITY:

Two years ago, a legislative effort was completed which mandated the revision of fluoride and particulate emission rules, as well as the fluoride in forage rule as they pertain to the Columbia Falls operation. Currently, we are in compliance with all applicable state and federal rules concerning fluorides and particulates. We also feel that at 100% operation we will be in compliance.

Montana recently adopted new PSD rules and, basically, there won't be any impact on current operations or even at 100%. However, if conditions ever warranted an expansion, there is a potential problem because the SO_2 increment in Glacier Park will have been used up.

WATER QUALITY:

Columbia Falls requires no discharge permits and has no related environmental problems. Recently adopted groundwater rules by the state will require permitting and monitoring but we don't anticipate any problems.

HAZARDOUS WASTE:

Spent potliners were initially classfied as a hazardous waste and we constructed a prescribed disposal area for them. Since the original EPA listing, potliners have been removed. However, it is felt that in the future they will be relisted. In the meantime, we dispose of them as hazardous wastes and the landfill will be used up in 1984 or 1985. Construction of a new disposal site will depend upon whether they are relisted as a hazardous waste by EPA.

We also have a small amount of hazardous waste in liquid form; primarily solvents, which have to be reported and disposed of. We handle this by contracting for off-site disposal.

Currently, we are evaluating various methods for PCB disposal. Federal rules required that our stored PCB's be disposed of in 1983.

MONTANA PREVENTION OF SIGNIFICANT DETERIORATION:

On Friday, November 19, 1982, the Montana Board of Health approved the final rule for the State PSD regulations. Of particular interest from our plant point of view is the portion of the regulation relating to sulphur dioxide emissions.

The baseline date for SO_2 was set as March 26, 1979. The baseline area is statewide. The Columbia Falls plant switched to high sulphur ARCO coke during the summer of 1982. As a result, the increase in SO_2 emissions resulting from ARCO coke emissions will count against the PSD SO_2 increment.

The allowable increment increase in SO_2 emissions for a Class I area such as Glacier Park is 5 ug/m^3 for 24 hours. The impact of the conversion to ARCO coke is addressed hereafter. Basically, we are in a position where we have consumed the Class I SO_2 increment but are allowed, under PSD, to use ARCO coke, since we were capable of using it prior to January 6, 1975. It does preclude us from any expansion of major modification which would increase SO_2 emissions.

If, in the future, we should consider any plant expansion which results in additional SO_2 emissions, we would be required to investigate the following:

I. Best Available Control Technology (BACT)

In order to offset increases of SO_2 due to expansion or modification, control technology such as SO_2 scrubbers on the A-398 stack gas effluent would probably be necessary.

ENVIRONMENTAL STATUS
(Continued)

II. Coke Supply

Consideration of a conversion back to a lower sulphur coke, to offset the additional SO_2, would be a less expensive alternative. In relation to this, the baseline concentration is calculated for a period of two years operation prior to the baseline date. During the period, March 1977 to March 1979, our carbon consumption was 10-15% higher than at present. This would be included as part of the offset.

III. Modeling

A review of models of our emissions might result in a more sophisticated model showing a reduced impact of SO_2. Less complex models tend to result in higher impact results. This is not to say, however, that a more thorough modeling evaluation might not result in higher SO_2 impacts.

EMISSIONS INCREASE:

The following assumptions were used in the emission calculations:

	Baseline (1980)	ARCO Coke
Production	940,000 lb./day Al	940,000 lb./day Al
Carbon consumption	0.6 lb./lb. Al	0.6 lb./lb. Al
Anode composition	71% coke 29% pitch	71% coke 29% pitch
Sulfur content	1.44% in coke 0.5% in pitch	2.6% in coke 0.5% in pitch
SO_2 emissions	13,176 lb./day	22,360 lb./day

These calculations show a 70% increase in actual emissions from the use of ARCO coke.

PSD REGULATIONS:

Stationary source construction in Montana is presently regulated by the federal PSD rules (40 CFR 52.21) and the "old" Montana PSD rules (ARM 16.9).

The federal rules require a permit for construction of a major stationary source or major modification for existing source.

52.21 (b) (2) (i) defines major modification as:

> "... any physical change in or change in the method of operation of a major stationary source that would result in a significant net emission increase of any pollutant subject to regulation under the Act."

52.21 (b) (2) (iii) provides that:

> "A physical change or change in the method of operation shall not include use of an alternative fuel or raw material by a stationary source which the source was capable of accommodating before January 6, 1975, unless such change would be prohibited under any federally enforceable permit condition."

The Montana PSD rules contain a similar provision.

16.8.901 (13) defines major modification as:

> "... any physical change in, or change in the method of operation of, or addition to a stationary source which increases the potential emission rate of any air contaminant under the Act."

16.8.901 (13) (b) provides that:

> "A change in the method of operation, unless previously limited by enforceable permit shall not include: ... use of an alternative fuel or raw material, if, prior to January 6, 1975, the source was capable of accommodating such fuel or material..."

The use of ARCO coke at Columbia Falls would result in a significant net increase in SO_2 emissions. Columbia Falls was capable of accommodating this change prior to Janaury 6, 1975. Sulfur content in raw material is not limited by permit or regulation. Accordingly, the change to ARCO coke does not constitute a major modification, and does not require a federal or state PSD permit.

MODELING:

The impact of the emission increase from ARCO coke was modeled using the BLP dispersion model. The model assumed operation of 5 lines, with 90% of the SO_2 being emitted from the dry scrubbers, and 10% being emitted through the potroom roofs. Nineteen eighty weather data was used from Glacier International Airport.

The predicted highest second high concentration with ARCO coke is 22.3 ug/m^3. This is a 9.2 ug/m^3 increase over 1980 levels. This predicted increase exceeds the 24-hour Class I PSD increment of 5 ug/m^3. All actual emission increases which occur after the baseline data must be counted against the increment.

Montana has proposed PSD rules which establish a March 26, 1979 baseline date. Although a PSD permit is not required to use ARCO coke, the resulting emission increase might have to be applied against the PSD increment. ARCO's comments to the Montana Board of Health have addressed this issue.

MONITORING:

The SO_2 monitors in use at Columbia Falls have a lower detection limit of 5 ug/m^3. Detection of an increase equal to the 24-hour increment would be difficult at best. Compliance with the Class I increment will most likely be based on modeling, not monitoring.

ENVIRONMENTAL PROTECTION PROGRAMS

AIR

CONTROL SYSTEMS

1. Dry Scrubber

The dry scrubber removes 99.8% of fluorides collected by the primary gas collection system, and recylces them as AlF_3, through the reduction cells (see attachment).

2. Sumitomo

The Sumitomo process, introduced in 1977, reduced cell operation fluoride emissions to approximately 700 lbs. per day from 2500 lbs. per day prior to the conversion. This was primarily a result of being able to keep the pots sealed much better than previously. Hydrocarbon and particulate emissions were also substantially reduced as a result of anode changes (i.e., dry anode).

3. Baghouse Systems

There are 14 baghouses and 2 venturi type scrubbers in the plant. Several additional baghouses are currently under construction. Most of the baghouses operate in conjunction with cyclone scrubbers. Particulate material collected by baghouse systems is recycled.

MONITORING SYSTEMS

1. Inplant

- continuous testing of roof monitors for fluoride and particulate.
- quarterly testing of dry scrubber for F.
- special testing on request (e.g., multiclone, paste plant, etc.)

2. Outplant

- 22 vegetation plots around the plant, plus 9 more in GNP - sampled 3 times per year.
- cooperative effort with the Forest Service for sampling six sites in the Park - sampled twice per year.

- 3 ambient air monitoring stations; monitors ambient F, SO_2, particulates.
- 1 meteorological station.

LAND

CONTROL SYSTEMS

1. Hazardous Waste Landfill

This landfill consists of a compacted impermeable clay base covered with 4 inches of gravel. The pad is contoured and shaped such that liquids percolating through the waste will encounter the clay and drain through the gravel to one corner of the pad. A piping system drains the leachate to a holding pond lined with an impermeable synthetic material. When closed the landfill will be capped with a clay liner, topsoil added and then revegetated.

2. Sanitary Landfill

This landfill is constructed on earthen materials meeting State regulatory requirements. Due to the inert nature of the waste disposed of at this site, an impermeable liner is not required. Cover material is applied daily. Upon closure this landfill will also be capped with clay and revegetated.

3. Drum Storage Area

All liquid petroleum wastes including lube oil, hydraulic fluids, soluble oil, contaminated fuel, solvents, paint thinners and lab wastes are disposed of in color-coded drums and stored in a specially designed storage area. This system allows for segregation of hazardous from non-hazardous and recyclable from non-recyclable wastes, and ensures compliance with hazardous waste regulations.

MONITORING SYSTEMS

Nine groundwater wells are in place throughout the plantsite. Four of these are production wells and five are for monitoring purposes. The monitoring wells will be sampled on a quarterly basis for cyanide, fluoride, and heavy metals in addition to basic parameters such as pH, solids and conductance.

WATER

CONTROL SYSTEMS

Holding Ponds

All plant waste water is discharged into two evaporation ponds. The ponds north of the plant receive paste plant cooling water and powerhouse condensate. Casting cooling water and sewage treatment plant effluent is discharged to the pond system adjacent to the Flathead River. Storm drainages also discharge into both ponding systems.

MONITORING SYSTEMS

1. Water discharges to the south holding pond are sampled and analyzed every two weeks for BOD, pH and solids. On a quarterly basis the pond and the Flathead River above and below the pond is analyzed for bacteria.
2. Both pond systems are sampled and analyzed for fluoride. By October 1981, these ponds will also be routinely analyzed for cyanide and heavy metals.

MISCELLANEOUS

VEGETATION TEST PLOTS

A local consultant, Dr. Mike Britton, has established nine native and three cultivated vegetation test plots around the plant for the purpose of determining the impact of fluoride emissions on various tree species. Vegetation within the plots are examined for fluoride damage (e.g., tree growth) and analyzed for fluoride content on a regular schedule. This is a long term project and could be conducted for approximately 10 years.

POLYCHLORINATED BIPHENYLS (PCB)

Heat transfer dielectric fluid is continuously analyzed for PCB's. As a result, an inventory of PCB's and PCB-contaminated materials has been developed. An area has been constructed for storage of PCB's and PCB-contaminated articles and equipment. A PCB inspection procedure that complies with Federal regulations is in place.

ENVIRONMENTAL CONTROL EQUIPMENT

(A.) Two Dry Scrubber Systems:

1. One dry scrubber system consists of four (4) reactors, servicing two (2) potlines.

2. One dry scrubber system consists of six (6) reactors, servicing three (3) potlines.

   The dry scrubbers receive the pot gas from thirty (30) individual fans, which exhaust pot gas from twenty (20) pots each, for a total of 600 pots. The pot gas is moved through a fluidized bed of alumina in the reactors where the hydro-carbons and fluoride is removed and physically combined with the alumina. Each reactor has a baghouse covering it for dust control. Each dry scrubber system also has two (2) nuisance baghouses for collecting miscellaneous dust. All baghouses are pulse-jet units, the reactor baghouses being 40,000 CFM and the nuisance being 4000 CFM. The total cost of the dry scrubber system, including, eighteen new fans and motors in Lines one (1), Two (2), and Three (3), was $5,300,000. Construction was completed in 1978.

   The duct collection system and original fans for Lines One (1) and Two (2) were installed in 1954-55 at a cost of $120,944.

   The duct collection system and original fans for Line Three (3) were installed in 1964-65 at a cost of $73,548.

   The duct collection system and original fans for Lines Four (4) and Five (5) were installed in 1967 at a cost of $146,704.

(B.) Sweepings Baghouse:

The sweepings baghouse was installed in 1982 at a cost of $53,001. This baghouse is a dust collector servicing the unloading of basement sweeping material and the unloading of special test materials for the paste plant. This is a pulse-jet unit with a capacity of 25,000 CFM.

(C.) West Unloader Baghouse:

The west unloader baghouse was installed in 1954-55 at a cost of $24,787. This baghouse was then converted from a sly flatface to a B.H.A. pulse-jet unit in 1981 at a cost of $26,558. This unit has a capacity of 25,000 CFM. This baghouse is a dust collector for the unloading of rail cars and alumina.

(D.) West Bucket Elevator Baghouse:

The bucket elevator baghouse is a sly flatface, with a capacity of 3000 CFM, and was installed in 1954-55 at a cost of $4,679. This baghouse is a dust collector for the alumina being transported by a bucket elevator.

(E.) West Storage Silo Baghouse:

The storage silo baghouse is a sly flatface, with a capacity of 2000 CFM, and was installed in 1954-55 at a cost of $6,891. This baghouse is a dust collector for the dumping of alumina in the storage silos.

(F.) East Unloader Baghouse:

The East unloader baghouse was installed in 1967 at a cost of $22,654. This baghouse was then converted from a sly roll-clean to a B.H.A. pulse jet unit in 1981, at a cost of $13,500. This unit has a capacity of 7,000 CFM. This baghouse is a dust collector for the unloading of rail cars of alumina.

(G.) East Bucket Elevator Baghouse:

The bucket elevator baghouse is a sly roll-clean, with a capacity of 5,000 CFM, and was installed in 1967 at a cost of $9,684. This baghouse is a dust collector for the alumina being transported by a bucket elevator.

(H.) East Storage Silo Baghouse:

The storage silo baghouse is a sly roll-clean, with a capacity of 2,400 CFM, and was installed in 1967 at a cost of $7,060. This baghouse is a dust collector for the dumping of alumina in the storage silos.

(I.) Chemical Silo Baghouse:

The chemical silo baghouse is a sly flat-face, with a capacity of 2,000 CFM, and was installed in 1954 at a cost of $27,501. This baghouse is a dust collector for the unloading of coke for the paste plant.

(J.) Pet Coke Storage & Distribution Baghouse:

This baghouse is a sly flat-face, with a capacity of 8,000 CFM and was installed in 1954 at a cost of $6,546. This baghouse is a dust collector for the coke storage silo and distribution belt to the paste plant.

(K.) Coke and Coal Unloader Baghouse:

This baghouse is a sly flat-face, with a capacity of 7,000 CFM and was installed in 1954, at a cost of $9,871. This baghouse is a dust collector for the unloading of coke and coal and the conveyor to the storage silos.

(L.) Anode Dust Control Baghouse:

The original anode dust control baghouse was a sly flat-face with a capacity of 16,000 CFM and was installed in 1954 at a cost of $17,002. In 1975, a new pulse-jet, 16,000 CFM baghouse was installed at a cost of $25,109. This baghouse is a collector from seventeen (17) pick-up points concerned with the production of anode briquettes.

(M.) Cathode Dust Control Baghouse:

The original cathode dust control baghouse was a sly flat-face with a capacity of 6400 CFM and was installed in 1954 at a cost of $9,721. In 1975 this baghouse was put on stand-by, and the original anode dust control baghouse was renamed the cathode dust control baghouse. This baghouse collects dust from the equipment used to produce cathode paste.

(N.) Dracco Dust Control Baghouse:

There are four (4) Dracco units inter-connected, with a total capacity of 2,252 CFM and were installed in 1954 for a total cost of $11,593. These baghouses collect the excess dust from the two (2) paste plant ball mills.

ENVIRONMENTAL CONTROL EQUIPMENT
(Continued)

(O.) Carbon Black Sandblast Baghouse:

This baghouse is a sly flat-face, originally installed on the west chemical silo in 1954, at a cost of $9,202, and a capacity of 3,200 CFM. In 1974 it was moved to the carbon block sandblast area. This baghouse collects dust from the sandblast process.

(P.) Cathode Par Shot Blast Baghouse:

This baghouse is a wheel-a-brator shaker, with a capacity of 3,526 CFM and was installed in 1970 at a cost of $15,650. This baghouse collect dust from the shot blast process.

(Q.) Pinhole Paste Drying Baghouses:

There are two (2) fuller Dracco, shaker type with a combined capacity of 4,530 CFM and were installed in 1965 at a total cost of $5,238. These baghouses collect dust from the past drying silos and unloading system.

(R.) Electro-melt Wet Scrubber:

This scrubber was originally built in 1968 at a cost of $12,000 for a spare pot gas scrubber, and is now installed over the electromelt furnace to scrub the fumes and collect the particulate emissions, and has a capacity of 9,832 SCFM.

ENVIRONMENTAL CONTROL EQUIPMENT
(Continued)

ENVIRONMENTAL CONTROL EQUIPMENT SUMMARY

EQUIPMENT	COST		YEAR	
A. Dry Scrubber System	$5,300,000		1977-78	
Lines Four & Five Fans (new)	60,000		1981	
Duct-work and Fans Lines 1 & 2	120,944	Fans	1954-55	
Duct-work and Fans Line 3	73,548	Fans	1965	
Duct-work and Fans Lines 4 & 5	146,704	Fans	1967	
B. Sweepings Baghouse	53,001		1982	
C. West Unloader Baghouse	24,787	$26,558	1954	1981
D. West Bucket Elevator Baghouse	4,679		1954	
E. West Storage Silo Baghouse	6,891		1954	
F. East Unloaded Baghouse	22,654	$13,500	1967	1981
G. East Bucket Elevator	9,684		1967	
H. East Storage Silo Baghouse	7,060		1967	
I. Chemical Silo Baghouse	27,501		1954	
J. Pet Coke Storage & Distribution Baghouse	6,546		1954	
K. Coke & Coal Unloader Baghouse	9,871		1954	
L. Anode Dust Control Baghouse	17,002	$25,109	1954	1975
M. Cathode Dust Control Baghouse	9,721		1954	
N. Dracco Dust Control Baghouse	11,593		1954	
O. Carbon Block Sandblast Baghouse	9,202		1954	
P. Cathode Bar Shotblast Baghouse	15,650		1970	
Q. Pinhole Paste Drying Baghouses	5,338		1965	
R. Electro-melt Wet Scrubber	12,000		1968	

TECHNOLOGY IMPROVEMENT PROGRAM

TECHNOLOGY IMPROVEMENT PROGRAM

I. INTRODUCTION

The Columbia Falls Reduction Plant has made significant advances in process technology during recent years. The Sumitomo project, started in 1977 and completed in 1981, brought the plant to the limits of the late 70's technology. Notably, Columbia Falls is still the only successful Sumitomo licensee in the western world.

In early 1982, a 10-point program of projects was proposed, which would provide significant energy, material and labor cost savings to the plant. This program became identified as the Technological Improvement Program, or TIP. Eight of the TIP projects are currently under investigation on a limited basis. Thus far, all of the projects appear to have much potential. The two remaining TIP projects, Anode and Cathode Optimization, are the subject of a $90 thousand AFC request. Approval of the AFC will permit a 20-pot test using the improved anode and cathode technologies.

In late 1982, a program was proposed for full-scale testing of the TIP projects in one pot room. This program became known as the Model Room Program.

It is the purpose of this report to provide an update on the status of TIP and the Model Room Program at Columbia Falls.

II. SUMMARY

1. The two projects outlined here, TIP and the Model Room Program, have the potential of bringing Columbia Falls' performance and labor figures to a point comparable to the most modern prebake.

2. The projects have very favorable financial indicators. The continuous rates of return are, TIP - 84%, the Model Room Program - 83%.

3. TIP and the Model Room Program enhance the competitiveness of the Columbia Falls Operation;

   - It will be the most efficient VSS plant in the world;
   - It will be a high-purity plant;
   - It will meet the most stringent environmental regulations;
   - It will be very labor-efficient;
   - With improvements in electrical energy efficiency due to TIP and the savings inherent in baking the anode with waste heat, the plant will see superior energy efficiency.

4. The capital requirements for 1983 are not large, since this would be a year of development. TIP would require \$1.9M and the Model Room Program \$0.55M .

III. BRIEF DESCRIPTION AND STATUS OF TIP PROJECTS

1. Cell Magnetics - A proven computer model was utilized to analyze cell magnetic effects. These effects are important due to the strong magnetic field induced by the electrical buswork. If not compensated for in buswork design, the magnetic field causes metal pad movement, which reduces current efficiency. The magnetics analysis performed on the Columbia Falls cell identified a serious deficiency. This deficiency can be corrected by changes in the anode buswork. The project will reduce cell energy consumption, increase current efficiency, and reduce metal inventory in the cell. One test pot is in service and is performing very well. Additional tests pots are planned in late 1982 and 1983.

2. Optimized Anode- Optimized Anode technology will reduce anode voltage losses and reduce carbon comsumption by improving anode primary and secondary pastes, and altering current operating procedures.

3. Optimized Cathode - Optimized Cathode technology will cut cathode voltage losses significantly by improving the cathode block, collector bar, and connecting joint.

4. Anode Effect Suppression - With Sumitomo technology, Columbia Falls experiences about 3.5 anode effects per pot day. When on anode effect, a cell is using excessive energy and not producing metal. Reducing the anode effects to about 1.5 per day is the goal of this project. This will be accomplished with sophisticated new computer control software and hardware. Testing is underway on one cell at present.

5. Advanced Ore Feeding System - Columbia Falls is currently testing a new ore feeding system designed to improve current efficiency, increase the stability of cell operations and reduce labor costs. Five cells are now in service using the new feeder system and are performing very well.

6. Enhanced Computer Control - IBM's maintenance of our process control computer will be eliminated in the near future. A new process control system is necessary and was planned before TIP. With the advent of TIP and the Model Room Program, the new system was configured to complement the TIP projects. The new system will have additional diagnostic programs, will have more

sophisticated control logic, and will more closely monitor the operations. With this project we expect a significant increase in current efficiency. Software development for this system in underway.

7. Pin Cleaning - Cleaning of the anode studs, or pins, is known technology which can reduce anode voltage losses and improve purity. This process will reduce iron sulfide scale which is formed when sulfur in the anode carbon reacts with the steel pins. If not removed, this scale creates high electrical resistance and ultimately ends up in the metal as iron impurity. Pins were not cleaned in the past at Columbia Falls due to cheap power and the lack of need for pure metal. A prototype pin cleaner is currently being tested at the plant. Substantial gains in metal purity are expected with pin cleaning, as well as voltage savings.

8. Anode Bus Widening - Anodes have been widened twice at Columbia Falls in the past to allow higher amperage levels. The four rows of anode pins however, were not moved accordingly. Since the Sumitomo project began, we have been trying to raise amperage but have been unable to, due to anode problems. It was discovered that the outer rows of pins were carrying far more current than the inner rows. Three pots from previous bus widending tests were studied for comparison. The study showed that substantial gains in current efficiency, anode voltage savings, and amperage level were possible. Ten test cells are currently undergoing bus widening. The one cell completed is demonstrating near-perfect current distribution.

9. Improved Cathode Shell - Early pot failures are very costly, not only from the rebuild cost that is incurred, but also from the large amount of cryolite that is absorbed into a new cathode. Studies on the present cathodes at Columbia Falls have revealed three weak points that contribute to a relatively low pot life. These are weak cradle beams, weak corners, and weak upper sidewalls. The solutions to these problems have been designed into a modified cathode shell proposal in the TIP project. This modified shell is anticipated to give at least one year extra pot life and will substantially reduce cryolite consumption at Columbia Falls.

10. Lithium Bath - The addition of lithium to the cells' bath is known to reduce temperature and improve current efficiency. A major problem at some plants has been

the tendency of alumina sludge to form in the bottom of the cells. We believe we can successfully control the use of lithium to the point of being very beneficial. A five-pot test is underway.

With TIP, it will be possible to realize significant overall process savings at Columbia Falls. Performance figures comparable to a modern prebake plant are indicated. With the energy savings which come from a self-baking continuous anode a highly competitive aluminum reduction facility is envisioned for Columbia Falls.

IV. BRIEF DESCRIPTION AND STATUS OF THE MODEL ROOM PROJECTS

The Sumitomo project at Columbia Falls produced substantial process savings, but produced a deficit on labor costs. With the indicated successes of the TIP testing so far, it became apparent that substantial labor savings were possible. These savings eventually developed into the Model Room Proposal.

Savings are based primarily on the elimination of a significant percentage of the mobile equipment fleet at Columbia Falls and replacing them with one multi-purpose crane in each Room. The cranes would be more efficient and require less maintenance. Tapping metal, anode paste additions, and alumina additions would all be done with the multi-purpose cranes. Pin pulling and bus raising would be done with the present ECL cranes.

This project was proposed to be installed in one Room where all of the advanced automation projects, including TIP projects, would be located. Thus, it became known as the Model Room Project.

With Model Room, it will be possible to reverse the labor deficit of Sumitomo into substantial overall labor savings. Labor rates comparable to the most modern prebake plants are indicated. This project is in the design stage, awaiting AFC approval.

FINANCIAL AND
OPERATING STATISTICS

COLUMBIA FALLS REDUCTION PLANT
RAW MATERIAL CONSUMPTION RATES

Material Consumption (lbs.) Per Pound of Potline Production	HISTORICAL 1978	1979	1980	1981	1982	1983 Budget
Alumina	1.939	1.951	1.958	1.931	1.96	1.94
Aluminum Fluoride	.044	.021	.021	.022	.025	.023
Cryolite	.045	.049	.024	.009	.013	.017
Petroleum Coke	.452	.437	.407	.413	.406	.406
Anode Pitch	.194	.187	.176	.177	.174	.174
Power (DCKWH)	8.40	8.31	7.83	7.64	7.82	7.95
Manhours Per Short Ton of Finished Production						
Hourly Employees	12.2	12.7	11.8	9.6	10.6	11.2
Salaried Employees	2.9	3.5	3.4	3.6	5.6	7.1
Total Employees	15.1	16.2	15.2	13.2	16.2	18.3
Operating Rate	95%	98%	99%	95%	61%	41%

COLUMBIA FALLS REDUCTION PLANT
RAW MATERIAL ACQUISITION COSTS

Acquisition Cost (Incl. Freight) Per Short Ton of Material ($)	HISTORICAL					1983
	1978	1979	1980	1981	1982	Budget
Alumina	152.47	160.04	187.13	220.35	234.06	256.86
Aluminum Fluoride	539.83	568.38	735.18	846.81	908.39	949.00
Cryolite	531.96	563.92	604.79	701.36	753.22	751.00
Petroleum COke	129.07	148.64	169.30	152.31	171.54	175.00
Anode Pitch	183.26	163.60	325.34	339.90	324.25	335.00
Average Compensation*						
Hourly Employees ($/Hr.)	12.17	13.10	14.04	16.59	20.00	21.13
Salaried Employees (M$/Yr.)	23.3	26.1	29.8	35.4	41.5	42.1

* Includes salaries/wages and fringe benefits.

COLUMBIA FALLS REDUCTION PLANT

HUMAN RESOURCE STATISTICS

	HISTORICAL					1983
Average Employment	1978	1979	1980	1981	1982	Budget
Hourly Personnel	1088	1124	1067	908	662	426
Salaried Personnel	245	293	306	322	289	207
Total Employment	1333	1417	1373	1230	851	633
Average Hourly Compensation ($/Hr.)						
Hourly Wage	9.08	9.71	10.39	11.98	13.56	13.62
Hourly Benefits	3.09	3.39	3.65	4.61	6.44	7.51
Hourly Compensation	12.17	13.10	14.04	16.59	20.00	21.13
Average Salaried Compensation (M$/Yr.)						
Annual Salary	19.6	21.9	25.0	29.3	32.7	33.7
Annual Benefits	3.7	4.2	4.8	6.1	8.8	8.4
Salaried Compensation	23.3	26.1	29.8	35.4	41.5	42.1

COLUMBIA FALLS REDUCTION PLANT
POTLINE PRODUCTION STATISTICS

	HISTORICAL					1983
Operating Rate	**1978**	**1979**	**1980**	**1981**	**1982**	**Budget**
Average Pots Operating	571	587	594	572	367	246
Total Pots Available	600	600	600	600	600	600
Percent of Capacity	95%	98%	99%	95%	61%	41%
Potline Production						
Pot Operating Days (M)	208.3	214.2	217.3	208.9	133.9	89.8
Average Amerage (M)	102.1	100.0	99.4	102.0	102.1	102.5
AMP Efficiency (%)	81.2	83.2	86.2	88.1	87.9	86.4
Potline Production (MM lbs.)	306.6	316.4	330.5	333.2	213.4	136.5
Pot Rebuilds						
Pots Rebuilt	210	311	102	83	54	61

COLUMBIA FALLS REDUCTION PLANT
ENERGY STATISTICS

	HISTORICAL					
Electric Power Consumption Per Pound of Production	**1978**	**1979**	**1980**	**1981**	**1982**	**1983 Budget**
Reduction Process - DCKWH	8.40	8.31	7.83	7.64	7.82	7.95
Total Power - ACKWH	9.38	8.97	8.42	8.19	8.52	8.85
Electric Power Rate (Mils/ACKWH)	2.50	3.43	5.74	8.03	19.07	26.6
Total Power Costs (MM$)	$ 7.2	$ 9.6	$ 16.0	$ 22.1	$ 34.7	$ 32.4
Natural Gas Usage						
Consumption (MMCF)	422	444	403	331	266	223
Cost Per MCF ($)	1.86	2.48	3.59	4.52	4.82	5.39
Natural Cost Costs (MM$)	$ .8	$ 1.1	$ 1.4	$ 1.4	$ 1.3	$ 1.2

COLUMBIA FALLS REDUCTION PLANT
PRODUCTION COSTS PER POUND

	HISTORICAL					1983
	1978	1979	1980	1981	1982	Budget
Finished Production (MM lbs.)	307.8	314.5	330.9	333.8	213.3	136.5
Production Costs (¢/lb.)						
Alumina	14.8	15.6	18.3	21.3	22.9	25.2
Aluminum Fluoride	1.2	.6	.8	.9	1.1	1.1
Cryolite	1.2	1.4	.7	.3	.5	.7
Petroleum Coke	2.9	3.2	3.4	3.1	3.5	3.2
Anode Pitch	1.8	2.5	2.9	3.0	2.8	2.9
Power	2.3	2.9	5.0	7.1	16.2	23.9
Labor	6.8	7.9	8.2	8.1	10.4	11.9
Maintenance & Operating Supplies	2.8	3.1	3.2	3.0	3.1	4.2
Others	.6	.4	.7	1.1	.8	3.2
Total Variable Costs	34.4	37.6	43.2	47.9	61.3	76.3
Depreciation	1.4	1.4	1.5	1.7	3.4	5.7
Other Period Costs	3.1	4.1	5.1	5.9	8.4	10.8
Total Costs	38.9	43.1	49.8	55.5	73.1	92.8